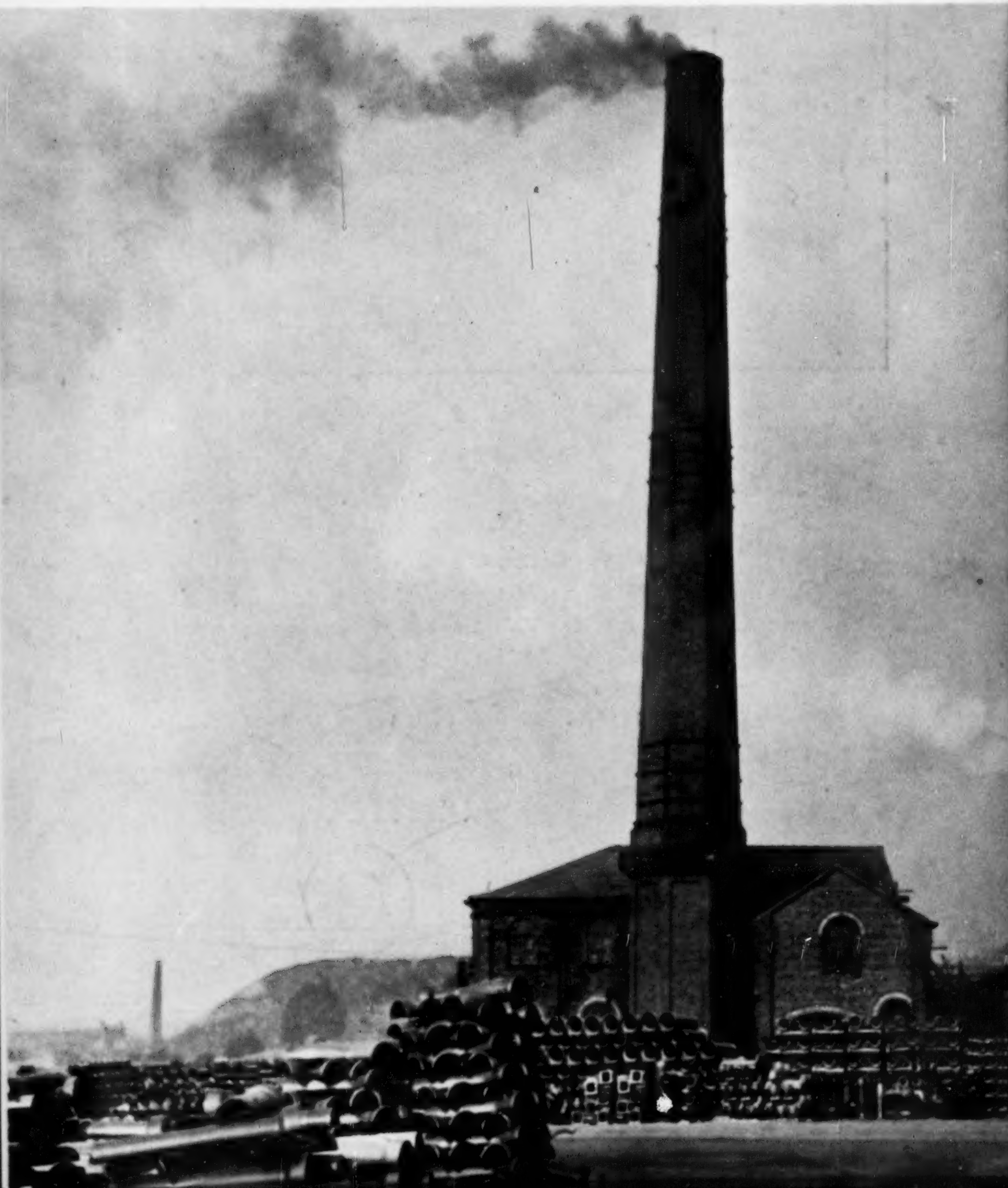
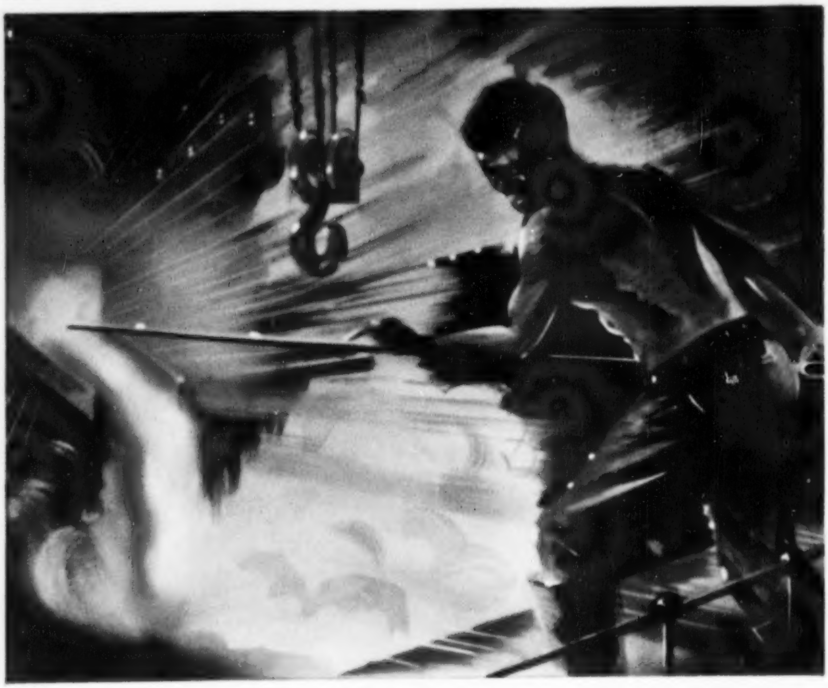
CERAMICS





Ceramics

VOL. II JULY, 1950 NO. 17

An Unimpressive Exhibition

THE Council of Industrial Design whilst setting out with the ostensible motive of making the consumer design-conscious and appreciative of the "better things" in life, have rather placed themselves in the position of Cæsar's wife. And Cæsar's wife fell from grace in no less a town than Darlington!

CERAMICS heard from the Council that there was a travelling pottery display which would be in the local museum. We arranged to see it. In the words of an eye witness—"A more pitiful collection I have never witnessed." It was displayed in a very small gallery, the door of which bore a crude notice, written in Indian ink on a crumpled piece of brown paper. The collection itself consisted of six cases, each containing an average of half-a-dozen pieces bearing typescript notes which were themselves examples of unimaginative advertising at its worst. The resident attendant who displayed no enthusiasm for the exhibition, reluctantly offered for sale booklets and pamphlets on Industrial Design in practically every field except pottery whilst venturing the opinion "You'd have thought they'd have sent a chap along to explain things!"

This is a mobile exhibition doing the rounds of the various towns. Our eye witness said that "to send such a miserable collection to Darlington, a spot where a large percentage of the inhabitants know, appreciate *and* collect good ware, is a most unfortunate move.

Must it be pointed out again that the cultural lead of the provinces in the realms of literature, art and craft is high indeed by comparison with a London suburb! The latter is used to ballyhoo but the former takes to it unkindly.

If this is a true story—and our eye witness is a reliable one—it is suggested that the Council withdraw this travelling exhibition at the earliest possible moment and if they wish to stage it again, seek help and advice from those who know the pottery trade.

CONTENTS

Soviet Science

• *by Argus* •

ONE thing the student of Karl Marx learns is the debunking of the "Great Man" theory. For Lenin said, "Our teaching is not dogma . . . life will show us."

Marx said that people and things were equally important and that both were changed by one another. He said that the good and bad in all of us was due partly to our parents and partly the house in which we lived.

Then a year or so ago the Russian scientist Lysenko came along with his idea of "new genetics." By this he meant that what you inherited was unimportant, but where you lived or your environment solely determined your character!

This in itself would have been fair and reasonable had it not been that in Russia itself one of the greatest experiments in this hypothesis was carried out. Something like 1,000 pairs of identical twins were brought up in different environments. The results proved quite conclusively that environment or where you lived only affected the individual to an extent of 50 per cent. The other unaccounted-for part was definitely due to parentage. One is sorry to say that this Institute, having published its findings to the world in all good faith has since been closed down and the experimenters "liquidated."

Lysenko had his run and was then forgotten as a nine-days wonder! Since he had no supporters outside the Communist press of every other country in the world, and since no scientist of repute bothered to take his theories seriously, he ceased to be an important figure.

Life from Lifeless Matter

But one hears of a new Russian discovery! A lady by the name of Olga Borisovna Lepeskinskaya has opened up a new approach to biology! She has succeeded in doing what for centuries men throughout the world have tried—namely, to make life from lifeless matter. As yet there seems to be no details, but it appears that the Russian textbooks on biology are about to be altered because the Academy of Science of the U.S.S.R. has decided she is right!

In most sciences the discoverer states his discovery—he outlines the manner in which the discovery was made and leaves it to other workers to repeat the work he has done himself. Lysenko says his opponents will not even trouble to repeat his experiments, although some have tried and all have failed. This time no details are available of how this "synthetic life" was made, so presumably it is difficult to repeat the work!

That however is in the field of biology, which at the best is still only half a science.

Reading the *Journal of Applied Chemistry*, published in the U.S.S.R. and enjoying a privilege of learning equivalent to the British or American Journals of the Chemical Society, politics indeed enter editorials! In January of this year the Editor said "All progressive mankind can see now that only a Socialistic system is able to guarantee a truly flourishing science; the sinking Capitalist on the other hand designs science a pitifully frozen and degrading position, one that makes it a servant of monopolistic capital . . . greater still is the future of the Soviet people under the leadership of . . . Joseph Vissarioonovitch Stalin." Which means in effect that if you put two things in a test tube in Moscow and repeat the experiment in London and New York, the results you get will be different!

But it goes even further than that! In 1725 the Russian Czar, Peter the Great, formed the "Academy of Sciences," modelled, strangely enough, on the Royal Society of London.

Academy of Sciences

Some time after the Revolution—in 1925—it was called the "Academy of Sciences of the U.S.S.R." It covers science, literature, language, philosophy, history, economics and law. It is ruled by a very select body of 139

academicians—of average age 65! It is infinitely more difficult to enter that body than the Royal Society of London. The latter requires a subscription, but the former pays a member a salary of no less than 5,000 roubles a month. They had liberal rations of food and clothing; they could shop at special stores; they were given cars; they were entitled to a comfortable flat in the city and for relaxation in summer time they had a large number of country cottages.

Annually elected members are made by the vote of the existing academicians. In fact, with the notorious exception of Lysenko, few appointments to the Academy are on political grounds and even these few do not weaken the imposing intellectual strength of the Academy.

Unfortunately this vast collection of intellect merely determine policy and then leave management to the officers and a large full-time staff. They control 57 institutes, 16 laboratories, 15 museums, 73 libraries and 35 research stations. Even in 1945, the scientific staff consisted of 4,213 workers and 600 research students, in addition to which there were large numbers of technical assistants, laboratory workers and so on.

No Age Limit

There is no question of an age limit for retiring. Academician Bach was on the job to the age of 90, controlling plant life; another, aged 69 directs the Moscow Medical College; another, aged 83, is in charge of Soviet geology.

What is surprising is that the Czarist intellectual holds the Academy firmly in his grasp! Suppose a man was young enough to have begun his university education just after the Revolution; by now he would be from 45 to 50—quite old enough to have made his mark in the scientific world. Yet only thirteen people born since 1900 had been elected to the Academy up to 1945! Six were writers of philosophy or economics, one was an explorer and only six were scientists.

In short, the policy of science in the U.S.S.R. is laid down quite definitely by those scientists who had reached maturity before the Revolution and they have been clever enough to keep out the post-Revolutionaries!

In this light it is interesting to look back upon what the Editor of the *Journal of Applied Chemistry* (U.S.S.R) has said—"Only a Socialistic system is able to guarantee a truly flourishing science"—but the system as practised in Russia seems unable to produce scientists itself! Instead it is controlled by men, the majority of whom have one foot in the grave and one unstably balanced at the graveside—and were trained by a reactionary Czar!

And just to remind Joseph Stalin—dear old Karl Marx also said, "Force is the midwife whereby the new social order is born from the womb of the old." The present Russian order might keep this firmly in mind—for *they* are now becoming the *old* order!

POROUS CERAMICS

AEROX LTD., Hillington Road, Glasgow, S.W.2, have developed their well-known range of porous ceramic materials.

Leaflets are available as follows:

B.7.A. describes the units for compressed air filtration to remove oil and other impurities where this is likely to be deleterious. Typical applications are for pressure lines feeding pneumatic tools, paint spraying guns and so on. Instructions for use, dimensions and performance details are given in the leaflet.

B.13. describes industrial porous ceramic tubes for aeration, diffusion and filtration. These are being used for the air agitation of electroplating tanks.

B.17. describes their industrial aerators and diffusers of the vertical, horizontal and star types.

B.15. describes their porous ceramic electrolytic diaphragms in the form of rectangles, cylinders and plates.

LANCASHIRE DYNAMO & CRYPTO LTD.

WE have received an interesting booklet from Lancashire Dynamo and Crypto Ltd., Trafford Park, Manchester 17, in which illustrations and details are given of their motors for use as power station accessories; their flameproof motors for mines, oil refineries, chemical works, gasworks, etc.; their motors and generating plant as used in gasworks; and their alternators as used in the manufacture of sugar.

Another interesting leaflet describes a hand and face dryer which eliminates towels.

Modern Trends in Manufacturing Bricks

SPECIALLY CONTRIBUTED

MANY articles have been published both at home and abroad since the 1939 war, dealing with modernisation of brick and tile plants. Since many of these were closed during the war, the past few years have provided the opportunity to reorganise and modernise production of these essential products.

In spite of the uncertainties created by mixing politics with house building, there will undoubtably be a large demand for building materials for many years to come—an additional incentive to capital expenditure for modernising plant. It will be the aim of this article to survey these developments and to indicate possible future trends.

Realising the need to produce as much building material as was possible to speed the housing programme, the Ministry of Works sponsored an enquiry by the National Brick Advisery Council which surveyed the present practices in the brick industry, prepared recommendations for economy in the use of manpower, and estimated the probable demands of the post-war industry.

Manpower Requirements

The report, which was issued in 1947 (Labour Requirements in the British Industry, H.M. Stationery Office) was accompanied by two papers entitled "The Getting of Clay" and "Labour Requirements," which were compiled by H. H. Macey and Dr. A. T. Green of the British Ceramic Research Association. These surveyed the results of over fifty brick works of all sizes, operating all the main types of making process—wire cut,

A Chaseside Shovel, working under adverse conditions

stiff plastic and dry press or semi-dry—and it can therefore be regarded as authoritative. The report recommends among other things that:

(a) Manual methods of winning clay and removing overburden be replaced by mechanical means when possible.

(b) Haulage systems should be designed to replace tramming.

(c) Working conditions and prospects should be raised by reducing the amount of dirty, unskilled jobs and increasing the proportion of skilled workers.

It was computed that the putting into effect of these recommendations should reduce the labour force required in the industry over pre-war by between 6,000 and 15,000 operatives.

This then is the target—let us see how it is being achieved.

Winning of Clay

The survey of current methods in the industry revealed examples of excessive use of manpower and indicated mechanisation as the means to be adopted to overcome the present shortage of that commodity. The winning of the clay is a notable example of the use of machinery to simplify an arduous and dirty job. The number of appliances available for clay getting is constantly increasing, and the choice of the one to be used depends very largely on the local conditions as is stressed in the paper on the getting of clay previously referred to. Roughly, the main classes of equipment are: (a) the mechanical shovel or navvy; (b) the drag line; (c) the bucket excavator and (d) the shale planer.

The Power Shovel

This appears to have originated in America in 1839 as an aid to railroad construction and was taken up by a few brick makers about sixty years later. A steam shovel was used in this country in one of the Fletton works in 1902, when there was a strike of clay getters. The innovation was at first no more popular then than its successors in more modern times, and it is recorded that the machine worked with an armed bodyguard. These machines were only taken up by those firms operating thick clay deposits which lent themselves to mechanical digging. Others kept to manual methods, and today 70 per cent. of the total number of brickworks in this country, contributing 35 per cent. of the national brick output, still use these methods. In some cases there are good reasons for this. There are in this country a large number of small brickworks making between five and ten million or less bricks a year. The clay required for this would not require the continuous use of a mechanical excavator.

The "Harbilt" electric truck, by the Harborough Construction Co. Ltd.

Factors Against Mechanical Clay Getting

Other factors which may make mechanisation difficult or impossible are: (a) depth of the workings; (b)

B.S.A. Truck Lever moving a line of loaded wagons with ease

rocks in the strata; (c) variations in the seams of clay, making it desirable to work individual seams. Nevertheless, in these cases there are appropriate machines which may simplify and cheapen the working. Some of these will be discussed later. Power shovels are probably the most widely used of the mechanical diggers today. They are used in about 75 per cent. of those works which have mechanised their clay digging and provide clay for about 30 per cent. of the national brick output. Originally steam


Electro-Hydraulics Ltd., fork-lift truck

operated, the mechanical navvy has now tended to be Diesel driven and on a caterpillar track chassis, while, where electric power from the grid is available, this can be used with the advantage of immediate starting in cold weather.

Performance of Power Shovels

It is a robust machine and can handle with ease the awkward type of material produced by blasting. Conditions of stability, however, limit the size of jib for a given load, which means that the height of clay face which it can dig is limited. For a deep working the face must be cut into benches or alternately blasted down and scooped up by the navvy from the bottom of the pit. It is comparatively fast in operation. Macey and Green quote the following figures for its performance:—

Fitted with an 8 c. ft. capacity bucket, it should dig 18 c. yd. of clay, equivalent to 200,000 to 250,000 bricks per week. Its digging height will be about 12 ft. A larger size machine, operating to 25 ft., would dig enough clay for approximately 2,000,000 bricks per week, and for an electrically operated machine of this size the power consumed was about 0·5 unit per ton.

The Drag Line

This is of more recent origin than the mechanical navvy and is finding increasing favour for all kinds of excavation of moderately soft material. The bucket is suspended from the end of the boom, dropped into the clay and dragged out to fill it. Although slower in operation than the power shovel, it possesses the following very solid advantages: (a) it can operate from ground level and cannot therefore be bogged in the bottom of wet pits in bad weather; (b) it can operate at greater depths than some other types.

Operation from ground level is a distinct advantage, since it simplifies transport of the clay to the works, avoiding awkward gradients. It can, for example, be mounted on a caterpillar track and the excavated material dumped on to a portable belt conveyor and thence to the works. Alternately, the material may be loaded into lorries or dumpers, light railway trucks, or even aerial ropeways. In all cases the loading can be done out of the mire, and on a level roadway or track.

In the latest type of drag line, manœuvrability is improved by a walking device. This is operated from the power drive on the machine and lifts it bodily, moves it and sets it down again. Turning is simplified and moderately steep gradients can be climbed if required. The jib can be longer on a drag line than on a power shovel and the radius of action thereby increased. These machines are now made in sizes digging from 1 c. yd. at a time upwards.

Against these advantages must be set the facts that the output is 10-20 per cent. lower than that of a mechanical shovel and the power consumption slightly higher. It is also restricted in use where the material to be excavated is hard or if strata of stones or rock occur in the clay. Nevertheless, for those deposits in which it can be used, the drag line is increasing in favour.

Ejecting Wet Clay from Buckets

An interesting piece of equipment which can be used with a drag line has recently been described (*British Clayworker* **58**,164,1949). This is known as the "Collier" Clay Core Ejector. It is designed to overcome the extraction of sticky clay from excavator buckets. It consists of a barrel fitted with a piston mechanism for ejecting the clay. This piston is operated by push rods and is held at the top of the cylinder by the hoist rope, the apparatus being attached to the drag rope. The cylinder is filled by dropping it into the soft clay and then hauled clear by the drag line. After hoisting to the jib head the piston is operated and ejects the clay. Using an experimental set-up, a clot of clay of 4 c. ft. in volume was dug and ejected and it is claimed that bigger types could be made.

The Multibucket Excavator

This is really a land version of the dredger used for recovering sand and gravel from under water. The buckets are mounted on an endless chain which operates on a frame, called the ladder. This is attached to the chassis which carries the machinery,

and a hopper for the excavated material. It normally runs on a rail track and is thus not as mobile as other types of excavators which are operated on caterpillar tracks. Like the drag line it is not suitable for the harder types of material and strata of rock, etc. cause difficulties in operation. Where the terrain is suitable, however, it delivers a well mixed material of small size. Like the drag line, too, it fits in well with mechanised transport systems.

Electric power is commonly used on this excavator and from the results of their survey, Macey and Green give the consumption as 1·1 units per c. yd. of moderately difficult material excavated. Lower figures are quoted in the trade literature.

The Shale Planer

This machine is more popular in the U.S.A. than here. It consists of a movable chassis carrying a series of knives on a moving belt, which is mounted vertically against the clay face, the clay scraped off being removed in buckets on an endless chain. The shale planer is suitable for use on uniform seams of not too hard material. It is claimed its use results in reducing the grinding and screening requirements.

Bulldozers, Scrapers, Dumpers, etc.

The last war saw the introduction into this country of large amounts of diesel and petrol driven equipment for moving earth and clay in connection with the construction of defence works and aerodromes. Some of this finds an application in clay working.

Bulldozers are very suitable for removing overburden, while lately oil driven dumper cars of a very manœuvrable type are being used in conjunction with light diesel operated mechanical shovels. The latter can scoop up a load of clay and run it to a hopper at fair speed, or can dump it quickly into a dumper car.

These vehicles have a small turning radius and are fitted with balloon tyres on wheels of such size they can be operated in muddy conditions without special road construction. They use a cheap fuel in diesel oil. It is apparent that steam operated excavators are now being replaced by the diesel engined type, which avoid the need for steam raising before work can commence.

The means adopted for transporting clay to the works, varies very much with the weight of material to be handled and local conditions. These again are fully set out in the report on the winning of clay previously referred to. The methods available are:

(1) Hand pushing or tramming.
(2) Haulage by locomotive.
(3) Haulage by direct rope.
(4) Haulage by endless rope or chain.
(5) Belt and band conveyors.
(6) Aerial ropeway.

Which method to be adopted depends very largely on the particular conditions encountered. Even on a small works tramming is now considered wasteful of manpower, and dumper cars, or a system of direct rope haulage up an incline, down which the empty tubs can run, is preferable. A more efficient haulage method is the use of an endless rope or chain since the labour requirements are light.

Belt and hand conveyors are increasing in favour particularly as they can now be laid and moved very quickly and offer an economical method of moving clay. They are normally of composition rubber or steel. A limitation to their use is that they can only negotiate curves in a vertical plane.

Aerial ropeways are excellent for moving material over difficult ground, but the cost of construction is heavy, mobility is difficult and usually a subsidiary haulage system has to be worked to bring the clay to the rope railway.

Making Methods

Mechanisation to avoid unnecessary handling of the clay ware is the keynote of all making processes today. This involves the use of conveyors, trucks, etc., to replace the labourer with a barrow, wherever possible. At the extreme end of the scale we see the highly mechanised set-up in a large works where the clay is delivered to the grinders on the conveyor belts, ground and elevated to screens and thence to hoppers. From thence it is discharged at a regular rate on to a steel band conveyor, which carries it to the making machines.

These operate on the semi-dry process and the bricks are delivered

straight from the machine to the kiln. To do this the brick press is run on rails alongside the kiln, and after each chamber is filled, it can be moved along until it is opposite the wicket of the next chamber.

Where it is not possible to use the semi-dry process, extrusion of the plastic clay, followed by wirecutting is very popular. De-airing the clay is a very good means of improving its green strength and reducing losses in handling. For special types of grogged brick, its use can give striking increases in strength of the unfired ware.

Modification of the Properties of Clay by Chemicals

Another way of improving the properties of clay is to modify its colloidal properties by the use of chemicals (flocculents and deflocculents). This has not yet, as far as is known, been widely adopted in the country, but has attracted considerable attention in the U.S. Thus the addition of small amounts of soda ash to brick clays prior to extrusion is claimed to decrease the tempering water required, improve workability, reduce power consumption, laminations, wear and tear on knives and dies, give smoother extrusion, increased green strength and lower firing temperature.

The fired strength is also said to be improved and fired porosity lowered (cf. Brick Clay Rec. **115**,50,1949) also H. G. Schurecht, J. F. McMahen and C. M. Lampman, *J. Amer. Ceram. Soc.* **25**,422,347,1942).

Dryers

Where dryers are used these are now designed to use waste heat as far as possible either by utilising exhaust steam, hot air from a tunnel kiln, or lately by drawing air through the cooling setting of fired intermittent kilns. It is claimed that the waste heat from a periodic kiln can dry a weight of ware equal to that fired (T. W. Garve, *Ceram. Age* **54**,357,1949).

For clays that are difficult to dry the humidity dryer has come to stay, but here again handling costs are reduced by automatic devices. An electronic machine has recently been described which loads brick pallets automatically (D. G. Gumpertz, *Brit. Clayworker* **58**,223,1949). It is claimed to be foolproof, to require only one semi-skilled operator and to run at a cost of a few pence per day. A single yearly routine inspection is required and the life of the valves should be about three years.

Fork lift trucks for loading and unloading dryers and for setting the bricks in the kiln offer a means of reducing labour costs and cutting losses.

Firing

Increased cost of fuel has focused attention in post war years on firing costs. Much has been written on the heat lost in firing continuous and intermittent kilns by ingress of unwanted secondary air through leaking brickwork and badly fitting doors. A check on the CO_2 content of the stack gases from time to time is worth doing and the Ministry of Fuel and Power now have a mobile laboratory which aims at educating the industrialist in routine control of firing to eliminate waste.

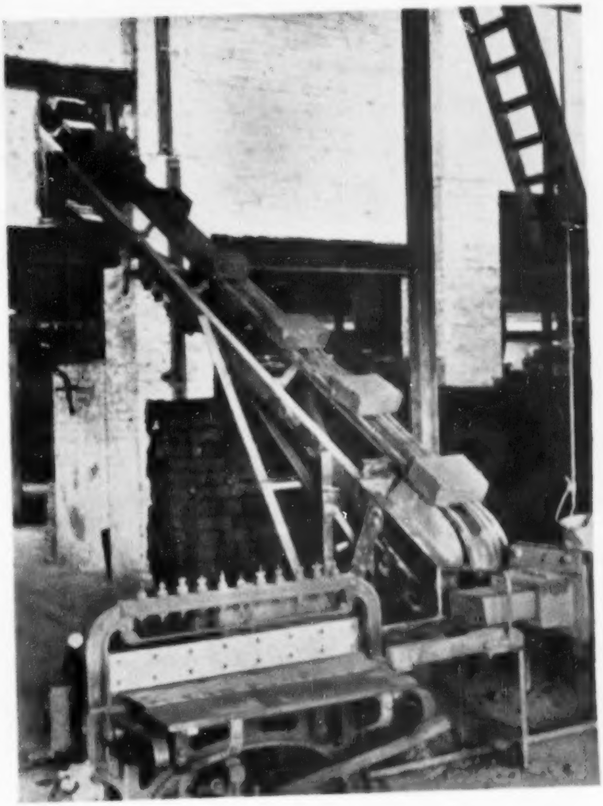
Automatic Stoking

Automatic stokers, especially of the overfeed type, are being increasingly used (cf. *Ceramics* **1**,624,1950) for stoking continuous kilns. They ensure more regular firing, savings in labour and a saving in fuel, since what is burnt is consumed more completely.

A more recent innovation in the brick industry is the use of the underfeed stokers for beehive kilns. This involves putting the stoker in a pit and building the kiln round it. The hot gases pass up a central flue to crown of the kiln and thence out of flues in the floor in the usual way. There are no bag walls and no firemouths around the walls. This increases the capacity of the kiln. Stoking is reduced to occasionally filling the hopper with coal beans and removing clinker. It is claimed that this method cuts fuel consumption and labour costs of stoking and eliminates smoke from the brickyard.

Tunnel Kilns

Bricks are tending to be increasingly tunnel-kiln fired in the U.S.A., but in this country bricks are already being fired very economically in continuous kilns so that with a few exceptions there is as yet no great changeover as far as building brick is concerned. Bricks



Slabs are received from pug mill cutting table and loaded by hand on to conveyor, which conveys them up a 30° incline and delivers over terminal to floor above

of course, have been fired in tunnel kilns here for over 25 years, but unlike some other branches of the ceramic industry there has not been a great changeover since the end of the war.

The reasons for this are not far to seek. Brick is a low priced product and the capital expenditure required to replace the output of a large Hofmann or similar kiln with tunnel kiln firing would be great. Nevertheless there are other considerations at work, connected with the scarcity of labour for kiln setting which lead some observers to believe that there may be a case for changing to tunnel kilns for firing building bricks (cf. A. Searle, *Brit. Clayworker* **57**.255.1949).

Advantages of Tunnel Kiln Firing

Some of the advantages to be considered are:

(a) Rapid rate of firing.
(b) The dryer can be built alongside the kiln and the loaded cars moved from one to the other without handling. Waste heat is used for drying.
(c) Very much better working conditions, e.g. female labour could load kiln cars with bricks.
(d) Handling is simplified as the tunnel can act as a conveyor.
(e) Absolute control of burning since the kiln does not depend on natural draught from a stack. The percentage of high-class brick is thus much higher and wastage is lower.
(f) Fuel consumption no higher than in a continuous kiln.

It is an interesting speculation as to whether the difficulty of recruiting labour for uncongenial work like kiln setting and drawing may speed the adoption of tunnel kilns, or whether mechanical handling devices may simplify this work and give the necessary improved conditions.

There are now available some


(Courtesy: The Mirrlees Watson Co. Ltd.)
Typical underfeed stoker

ingenious machines for rapidly handling fired and green bricks. Some modifications of existing kilns to give larger wickets may be required to enable these to operate to the best advantage, but this should not be a difficult task.

One of the difficulties of mass handling of bricks in the past has always been the need for pallets which prevented rapid stacking on the kiln cars. Machines have now been designed and used in U.S.A. to overcome this difficulty and a new device for a similar purpose has recently been patented in this country.

There are two types of apparatus at present used for handling bricks in bulk—one a fork lifting truck device and the other a brick lifting fork used with a crane. With either, a lorry can be loaded in a few minutes.

Fork Lifting Trucks

In the fork lifting truck the bottom layer of bricks is gripped between the jaws of the fork and held together by frictional forces the layers above resting on bottom layer. In the English version of this (Brit. Pat. 633,180) a rubber gripping device is used on the prongs of the fork. Such a machine would make short work of setting and unloading a kiln providing there was suitable access. It could also stack the bricks in the yard or load them direct on to trucks.

At the Sacramento Brick Co., California (*British Clayworker* **59**.16.1950) the bricks are dealt with in units of 1,024 each. The bricks from the dryers are loaded into setting boxes holding that number and these are taken to the kiln on a fork lifting truck.

Here the setting box is unloaded with the aid of a Priester brick fork, without disturbing the bricks and they are placed in the kiln as a unit. After burning, the same apparatus lifts out the 1,024 bricks and places them on the delivery truck. Each truck has two compartments each holding 1,024 bricks and it is possible to tip each separately in case only half a load is required on any site.

The Priester fork, like the device already described on the fork lifting truck, holds the bottom layer of bricks fast between the tines of the fork and the others rest on that in such a position that the fork can readily be withdrawn and inserted again after firing.

The brick fork is also used at the works of the Pola Brick Co., Connecticut, where with its aid and that of a mobile crane, an operative can handle approximately 100,000 bricks a day, half dry and half fired. At this works the bricks are handled in units of 600 and after leaving the dryer, all handling is done by the fork and crane. Two of these units, i.e. 1,200 bricks, are handled at one time by the crane and fork and placed right on the tunnel kiln car (the crane operates from an overhead track). Two loads, i.e. 2,400 bricks constitutes a car load. Unloading is done similarly. The crane deals with the whole output of 50,400 bricks per day. Such devices obviously cut handling costs tremendously. It is now possible in America to take delivery of bricks in standard packages.

Future Sizes and Shapes

Finally, it is interesting to speculate on the size and shape of the building bricks of the future. Serious consideration is now being given on all hands to the possibilities of reducing

building costs. Most people are agreed that housing is one of our greatest social problems today and the need is for houses at rents which the people can afford. Two lines of attack are being studied, bearing in mind that labour charges form a very high proportion of the cost of the finished house. One is to prepare a unit brick of larger size, but of the same weight, which can conveniently be handled by the bricklayer, and the other is to mechanise the movement of bricks on the building site.

From the point of view of the clay industries the interesting point is whether, in the future, economic necessity will create a demand for a new type of hollow building block which could be extruded. These are used extensively in America, but so far in this country their use is mainly restricted to the preparation of floors and interior walls.

PRESSURE CONTROL

INFORMATION leaflet NS.17 is available from the British Thermostat Co., Sunbury-on-Thames, Middlesex, describing their new Teddington pressure control Type QY.

As supplied, the instrument has three standard adjustable ranges between the limits of 28 in. of mercury vacuum and 250 lb. per sq. in. for low, medium and high pressure duty. The range adjustment is outside the case, whilst inside and quite easily accessible are the calibrated range scale and a graduated differential adjustment. A single-pole double-throw switch will make or break a circuit on pressure change. With alternative connections, the unit is suitable for refrigeration installations, whilst the changeover function of the switch can be used to operate an alarm.

The leaflet gives a full specification and dimensions of the instrument in question, together with details for wiring up.

Change of address.—Zirconal Ltd., have now removed from "Claver House," Wells Park Road, Sydenham, S.E.26, to 25 Clyde Vale, Dartmouth Road, Forest Hill, S.E.23. This has been necessary owing to the increased demand for Ethyl Silicate bonded refractories.

(James Royce Electric Furnaces Ltd.)

Fig. 1. Small general purpose kiln designed for operation at temperatures up to 1,250° C. A special feature is the small combustion chamber fitted under the firing chamber, for the generation of special reducing atmospheres

Some Notes on Modern Electric Intermittent Kilns

by

H. D. HENDRICK, A.M.Inst.F., M.J.Inst.E.*

ELECTRIC kilns, ranging from small intermittent units to large tunnel and continuous conveyor kilns, have been in use for many years. Constantly improving production methods, development of glazes, vitreous enamels and gilding metals, to meet modern demands for high quality tableware, has made the electrically heated kiln increasingly popular. The inherent cleanliness of electrical heating is especially suited to the firing of pottery and glass. Heat transfer uniformity and fully automatic temperature control are also typical features which provide a higher class ware. These conditions are ensuring reduced rejects, particularly in decoration where a high degree of "matched" ware is obtained.

* Technical Sales Manager, James Royce Electric Furnaces Ltd.

Particular attention has been given to the thermal efficiency so that the consumption costs compare very favourably with fuel-fired kilns. Further economy is achieved by the elimination of the need for saggers. It will be evident that reduced heat losses also ensure temperate working conditions.

Pottery Kilns

The kiln illustrated in Fig. 1 is a typical general purpose unit as used by potters producing specialist ware, and as an experimental kiln for research and development in large potteries. The design is also popular for general work in studios, universities and technical colleges. This unit has a chamber size of 14 in. wide, 16 in. high, 30 in. long and is rated at 12 kw. It is designed for temperatures up to 1,250° C. and may be used for either pottery or glass. A special feature of this equipment is the small combustion chamber situated under the firing chamber. This is for the burning of saw dust, leather and similar materials, providing a reducing atmosphere in the firing chamber. The use of this method for obtaining a variety of beautiful lustres by reducing metallic oxides contained under or in pottery glazes, has been known for many centuries.

This chamber may also be used as a ventilator to obtain the oxidising atmosphere required to oxidise the carbon created by burning off the collodion film and gum usually present in transfers. Air entering this chamber is preheated before reaching the firing chamber, thereby avoiding cold impingement upon the ware. The separation of the combustion chamber from the firing chamber is an advantage as it permits the replenishing of the combustible material without opening the main door. Possibility of particles of the medium, such as saw dust, or the ash adhering to the ware, is also avoided.

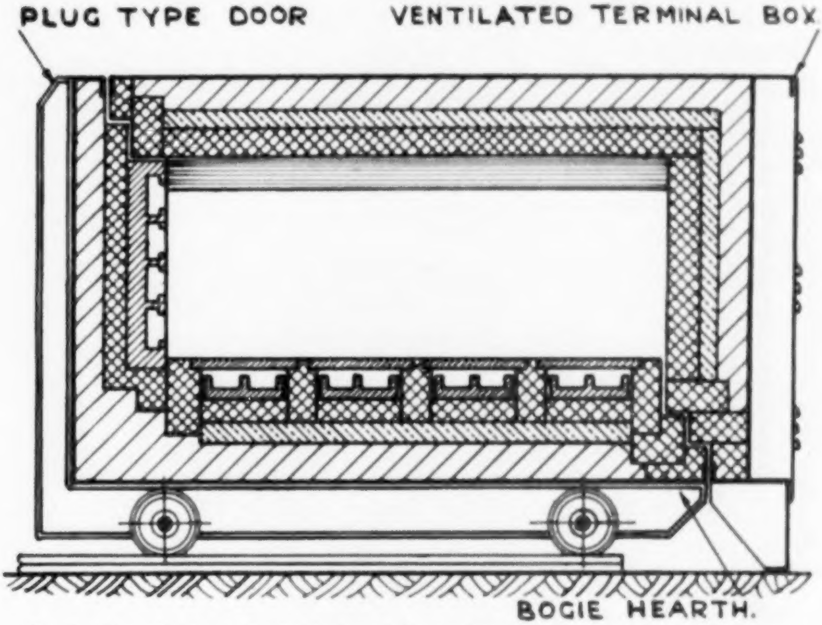


Fig. 2. Line drawing of a bogie hearth intermittent kiln. The hearth, complete with plug type door is withdrawn clear of the heating chamber for placing and unloading. Heating elements are arranged in the hearth, door and side walls

Combustion is achieved by electric heating elements and a regulated rate of burning is provided by adjustable air inlets and a vent fitted with a damper. Gas inlets may also be included to provide for further research

and development in the use of special atmospheres.

Heating elements are of heavy gauge Kanthal alloy wire, housed in open groove sillimanite tiles in the roof, side walls and hearth. The element lead-outs have an increased thickness to reduce electrical resistance where passing through the back wall, to insulated connections enclosed within a ventilated terminal box at the back of the unit.

A similar small unit has a large capacity drying chamber in place of the combustion chamber mentioned above.

Intermittent Kilns

Box or batch type intermittent kilns having a rectangular or cylindrical chamber are well known and many are in use operating at temperatures up to 1,250° C.—1,300° C. These are very popular where the output required is not sufficient for a continuous kiln. One disadvantage to large box-type kilns is the difficulty of placing and unloading; the unit shown in Fig. 2 is an improvement upon the usual intermittent kiln, as it provides facilities for placing ware clear of the kiln chamber, ensuring effective use of the available space. The hearth is in the form of a truck or bogie, mounted on ball-raced rail wheels. For loading and unloading, the hearth is withdrawn, simplifying the building up of bats and cranks and placing the ware. A plug type door is built on the bogie hearth and this is firmly clamped to the main structure when the hearth is in position. Heating elements are arranged in the bogie hearth and door as well as in the chamber side walls in order to ensure an even heat distribution and temperature uniformity.

Accelerated cooling cycles may be achieved by the regulated withdrawal of the truck. An increased production may be obtained by having two bogie hearths mounted upon a double transfer truck.

To minimise consumption in heating up the kiln body on intermittent operation, high density refractory is replaced where possible by the excellent insulating refractories now obtainable. These, on an average weigh less than 25 per cent. of normal refractories and have a comparative thermal conductivity of 30 per cent. It is, therefore, possible to combine an efficient thermal insulation with a reduced sensible heat absorbed by the kiln body.

For temperatures up to 1,250° C. the heating elements are of Kanthal or similar alloy, usually in the form of a sinuous tape arranged in slots. To permit the use of very heavy gauge tape, for a long operational life, a transformer having a low voltage secondary is often employed. Temperatures above 1,250°-1,300° C. require non-metallic resistors, such as silicon-carbide or "Sillit" rods. These elements are used upon small kilns up to about 10 c. ft. capacity, where temperatures up to 1,400°-1,450° C. are required. The elements are individual rods, suitably connected to give the requisite resistance. The elements are very easily removed and replaced. Resistance of carbon rod elements increases with service; therefore if the voltage remains constant it will be evident that the amperes will drop with a corresponding reduction in the kw. rating.

For small experimental or laboratory kilns, the unit is often over-rated so that there is no loss of efficiency due to deterioration of the elements. It is preferable to have some form of voltage regulation so that variation in element resistance may be countered by adjustment of the input volts. The usual method is to employ a transformer having a number of tappings, often with coarse and fine adjustment steps. Stepless variation voltage regulators are also successfully utilised.

It may be mentioned here that some form of voltage control is advantageous upon all type kilns so that the input may be adjusted to suit the consumption for various cycles and conditions.

For china decorating and some glost kilns, heating elements are of an 80/20 nickel chromium alloy in wire coil or sinuous tape form.

Control Gear

Fully automatic temperature control gear is, naturally, a most desirable feature on all kilns and is very successful where applied to electrically heated units. For small kilns constantly attended by an operator, it is possible to rely upon a temperature indicator and hand switch. Where this method is employed it is an advantage to use

PLANNED HEATING AND VENTILATING

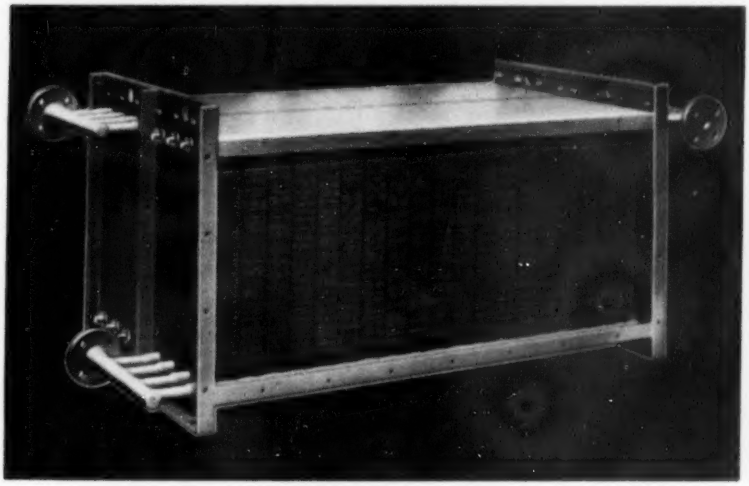
AIR HEATERS FOR PROCESS WORK

It has long been agreed that to dry efficiently, it is essential to have fresh supplies of air as well as heat. The Weldex Heater Batteries for this type of Heating are similar to those supplied for plenum systems but have unlimited application for process work equipment. Temperatures within 20 degrees F. of the heating medium can be obtained and any quantity of air dealt with. Typical applications already in operation are:

1. Milk Bottle drying.
2. China Clay drying.
3. Leather drying.
4. Cotton and Wool drying.
5. Paper drying.
6. Flax and Linen drying, etc.

In addition, such things as Sand Cores or Moulds can be dried in this way with steam pressure under the 100 lb. per sq. in. mark. The Weldex Air Heater is very robust, and of all steel construction. Weldex also specialise in the design of efficient Cooling Systems, the necessary information required being:

1. Volume or Weight of air to be cooled.
2. Inlet air temperature.
3. Required outlet temperature.
4. Humidity Conditions.
5. Cooling medium and its flow and return temperature.



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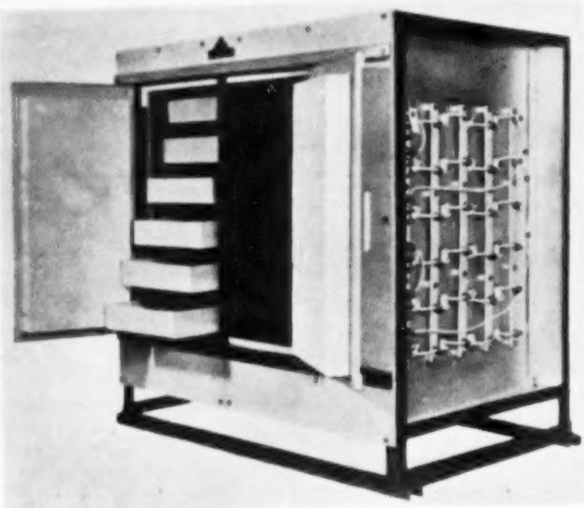

Fig. 3. Glass annealing and decorating kiln, specially designed for scientific glassware. Heating elements are of the industrial tubular type giving an increased radiating surface ensuring maximum heat transfer in the lower temperature ranges. The elements are individually removable through the side wall of the kiln

(James Royce Electric Furnaces Ltd.)

an energy regulator, or, where the rating permits, a rheostat so that the input may be adjusted to suit the required conditions. It will, however, be appreciated that any form of hand control is dependent entirely upon the operator and cannot be expected to give the results achieved by a fully automatic gear.

The usual temperature control gear comprises a thermo-electric couple which, when heated, produces a small e.m.f. This activates automatic controller usually of the galvanometer or potentiometer type. The instrument, which also gives temperature indication, may be pre-set at any required temperature within the range. Through a suitable contactor, it controls the input to the elements so that the heating chamber temperature is maintained within very close limits of the setting. If required, another instrument provides upon a chart, a permanent record of the temperature gradient. A further refinement is a programme controller instrument, which has cams designed to automatically provide a required time-temperature cycle.

Glass Kilns

The essential features of glass annealing and decorating kilns are temperature uniformity and control. For decorating in particular a clean oxidising atmosphere, free from products of combustion, is very necessary. The modern electric kiln fulfils completely these requirements and is usually recommended by glass technologists and enamel manufacturers.

The firing procedure for decorating is similar to that for annealing. Glass ware enters the kiln at ambient temperature and the temperature is slowly increased. To avoid the necessity for a comparatively expensive programme regulator instrument, it is necessary that the electrical rating of intermittent glass kilns be carefully calculated to give the correct heating cycle. The carbonaceous matter contained in enamel mediums and in the collodion film of transfers, begins to burn off at about 350° C. It is essential that the glass is heated slowly through this period in order that the vapours from the oxidised carbon are allowed to percolate through the enamel. A too fierce heat and quick temperature rise will result in the trapping of fumes and carbon in the enamel when the latter begins to sinter at about 450°-500° C. An adjustable ventilator and a fume vent with damper is required to give a good oxidising atmosphere during the early heating period. Provided that the temperature rise is uniform and sufficiently slow, it is not necessary to pause in heating to permit the carbonaceous fumes to escape. The final fusing of enamel to glass takes place between the range of about 520°-620° C. dependant upon the enamel.

Heating up should be slow and steady, taking approximately 90 minutes to reach fusing temperature; the temperature should then be maintained for about 10 to 15 minutes before cooling off in accordance with general annealing practice. For thick ware or a heavy load of glass a slightly longer time is allowed. Calculations based upon actual practical tests have made it possible to achieve the required conditions by careful heating element design; an elaborate time temperature control gear is, therefore unnecessary.

Pyrometric Control

Accurate pyrometric control is, of course, very necessary. This applies in particular to the firing of liquid metals on to glass. To obtain the very best adhesion and durability, it is recommended that the temperature should be as high as the physical properties of the basic glass will allow without distortion. It will be appreciated, for example, that when firing at a temperature of 620° C., a slight over-run of temperature may ruin a kiln load of glass ware.

To ensure the maximum degree of temperature uniformity, all modern kilns have a muffle to distribute the heat, preventing direct radiation from the elements. The Stefan-Boltzman law states that heat radiated per sq. ft. from a surface at a temperature T1 to an atmosphere at a temperature T2, is

$$0{\cdot}173E\left[\frac{(T1 + 460)^4}{100} - \frac{(T2 + 460)^4}{100}\right]$$

B.Th.U. per hour, E being the emissivity or quality of the surface exposed as a decimal of a perfect radiator known as "black body radiation"; this has a maximum value of 0·173 as a constant when working in degrees Fahrenheit and B.Th.U. From this it will be seen that heat transfer in the lower temperature ranges is comparatively small per unit area of radiating face. It follows, therefore, that with a small heating area the radiating temperature must be high in order to transfer sufficient heat. This, obviously, would not be suitable for glassware and an increased area at a

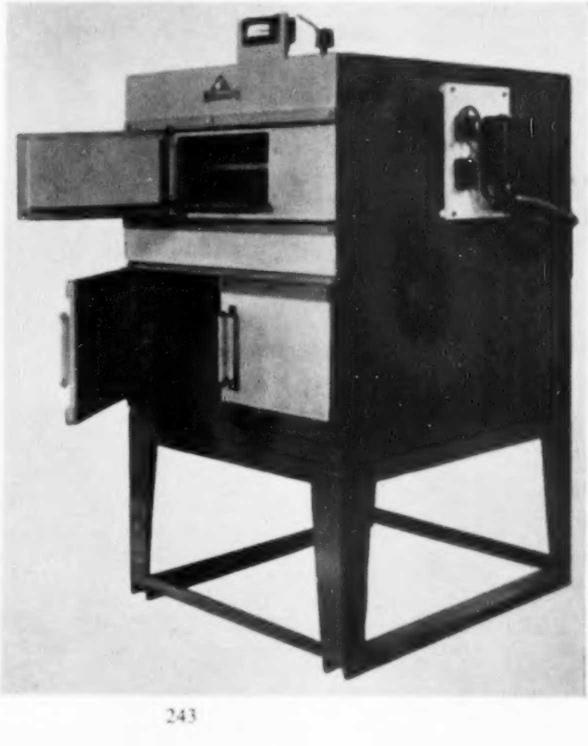

Fig. 4. Electric furnace for the firing of stained glass. The unit illustrated has a small firing chamber accommodating two trays and a larger preheat / cooling chamber with a staggered stacking arrangement

(James Royce Electric Furnaces Ltd.)

lower temperature is far preferable.

Advantage of Tubular Heaters

The unit shown in Fig. 3 was designed for annealing and the firing on of graduations, scales and other numerals for scientific glass ware. The kiln illustrated has specially arranged industrial tubular heaters comprising heavy gauge 80/20 nickel chromium wire in coil form housed in moulded refractories. The elements and refractories are enclosed within heat resisting steel tubes, thereby giving an increased radiating surface to dissipate the heat. As will be seen from the photograph, the tubes run laterally across the chamber, actually forming runners for the charge trays. By this means, the heating is evenly distributed throughout the chamber and surrounds the work being treated. This is a great improvement over the usual method of relying upon radiant heat from the side walls.

A further advantage of tubular heaters is that each element is individually removable, considering simplifying exchange of elements. The connection chamber is housed in the main casing. In the illustration (Fig. 3) the ventilated terminal box covers are removed, showing the layout of connections.

Economical and Efficient Size

The usual general glass decorating/annealing kiln for tableware comprises a chamber about 2 ft. square by 2 ft. 6 in. deep, fitted with a heat resisting steel muffle baffling the heating elements. This is found to be about the most economical and efficient size kiln and for many applications is more suitable than a continuous kiln or lehr. The chamber is fitted with angle runners at 2 ft. to 3 ft. pitch, providing accommodation for a variety of sizes ranging from small wines to lagers, jugs, etc. Trays usually consist of angle iron frames fitted with a loose perforated plate bottom. A feature of these smaller kilns is the door which is hinged at the bottom, arranged to swing forward and downward. This arrangement is very useful as it permits accelerated cooling. The door is fitted with a quadrant so that it may be opened and located in any position. By this means, the cold stream of air, entering the kiln, passes along the top of the chamber thus avoiding direct impact on the glassware. It is also possible to inspect the ware whilst still at elevated temperatures. To overcome door losses and to maintain temperature uniformity from front to back of the chamber, the door is fitted with a baffled heated panel.

Stained Glass Kilns

Electrically heated stained glass kilns may be divided into two types, termed "open" and "closed." The open type as shown by Fig. 4 comprises a small firing chamber accommodating two or three trays and a larger preheating/cooling chamber fitted with shelves for twelve or more trays. This type is popular for the firing of stained glass on a production scale, as one small unit can handle large quantities of glass with a most economic consumption. On an average, assuming electricity at 1d. per unit, stained glass may be fired at a cost of 9d. for 10 sq. ft. during a continuous production run.

Tho system employed is as follows—a tray of fired glass is quickly removed from the upper chamber and placed in the lower where it cools, imparting the heat absorbed to trays awaiting firing. The preheated trays are then moved individually to the firing chamber for short cycle heating. It will be appreciated that the recuperation obtained by this method ensures the minimum waste of heat. To simplify the transfer of trays, stops are fixed to the tray runners, adjusted to provide a staggered stacking. A tray lifting tool is supplied with the unit. The glass lays upon a loose plaster of paris bed within the trays and it is found that the sensible heat contained in the tray and bed are sufficient to protect the glass from sudden cooling during transfer from one chamber to another.

Specialist Kiln

The "closed" type of kiln is more popular with artists and specialists; it consists of one firing chamber housing about six trays. In this kiln, the glass is heated up from cold and allowed to cool down in the closed chamber, one or two firings a day being sufficient for most requirements. A small single tray chamber is usually provided


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to this unit for use when very small quantities are required.

Control of Glass Kilns

Many glass kilns are hand controlled by the operator who relies upon a galvanometer type indicating pyrometer. In view, however, of the comparatively low eutectic point of glass, accurate automatic temperature control is most desirable. The control gears mentioned earlier may be applied to glass kilns, but many operators prefer a thermostatic type control which switches off the current when the required temperature is attained. The thermostat then has to be reset by a push button before heat can be restored to the kiln. It will be obvious that this method has many advantages for glass kilns. A well-constructed kiln will maintain a steady maximum temperature for some 20 minutes after switching off, before the temperature starts to fall. Having ascertained that the heating up rate is suitable, it is possible to switch on the unit and leave it unattended as it will switch off at the pre-determined temperature and slowly cool. However, when firing enamels, it is still necessary to control the ventilation during the early stages.

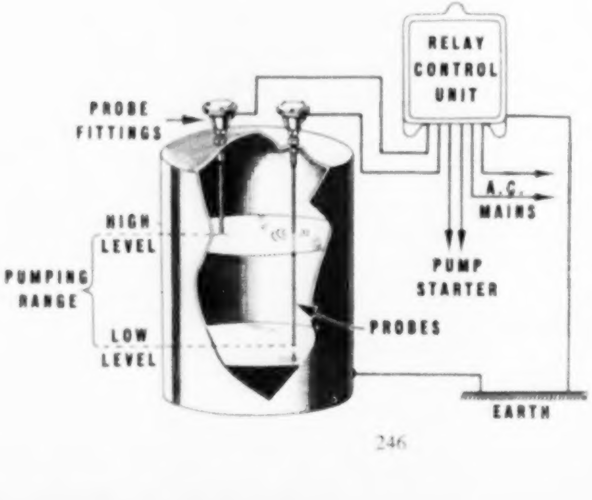
To ensure slow firing after the initial heating of the chamber, many glass kilns are fitted with a Star/Delta switch so that the resistance heating elements are connected in a Delta circuit for a full load current, and switched to a Star circuit to reduce the load to one third.

The author wishes to express his appreciation to Johnson, Matthey and Co. Ltd. for permission to use some of the information contained in this article.

AN AUTOMATIC FLUID LEVEL CONTROL

WE have received from Elcontrol Ltd., 10 Wyndham Place, W.1, details of the above control for the automatic operation of pumps, valves, heaters, alarms, etc., in accordance with the change in level of fluids. It replaces float switches, pressure bulbs and so on. Basically it consists of an electrode or probe system, which makes contact with the fluid at the control levels. The probe system consists of one or more metal rods suspended from insulated terminals to which the control unit is connected. It will control a wide variety of fluids from gritty, abrasive and corrosive liquids like bauxite-caustic slurry to boiler water. Our illustration shows diagrammatically how the control operates.

Acid-Proof Hose.—A leaflet is available from the Hose Division of the Goodyear Rubber Co., Wolverhampton, describing hose for steam, acids, alkali and chemical solution resistance. Examples of use are quoted as in tanneries, as well as acid, steel and chemical plants. The Company have developed industrial rubber hose to deal specifically with various problems such as acid suction, acid delivery, low pressure steam and so on.



Diagrammatic drawing of the automatic fluid level control, showing how the control operates

Scottish Souvenir Competition

ENTRIES numbering 550, some from as far south as Kingston-on-Thames, were received for the Scottish Souvenir Competition, organised by the Scottish Committee of the Council of Industrial Design.

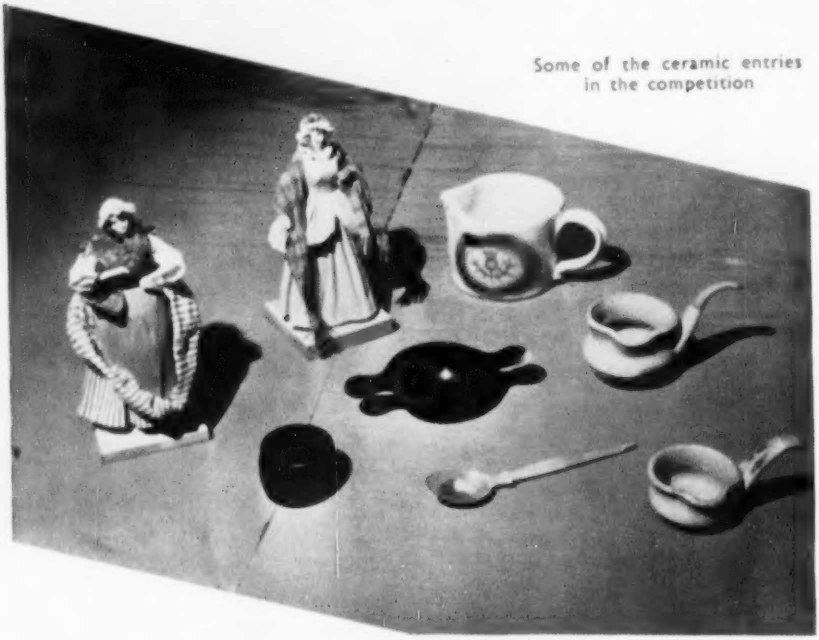
Speaking on the competition, Mr. Wyndham Goodden, chief officer of the Scottish Committee said: "Particularly notable amongst the entrants was the work of Mr. Harold Gordon. Mr. Gordon is a former pupil of the Design School of Edinburgh College of Art and after his war service which seriously impaired his health, set up on his own in Forres. One of the things for which he is particularly well known is his charming series of wild flowers in engraved glass.

"One of the difficulties which Mr. Gordon is encountering is in the supply of plain glass and incredible though it may seem this Scottish craftsman is obliged to use glass from London because he has been unable to induce Scottish glassmakers to give him a suitable supply.

"Another noble entrant is Miss Alison Geisler, also a former student of Edinburgh College of Art.

"The entries from Buchan's old-established pottery in Portobello are extremely good and most attractive, and the originality of the earthenware paper-weights by Ernest M. Dinkel should also be noted.

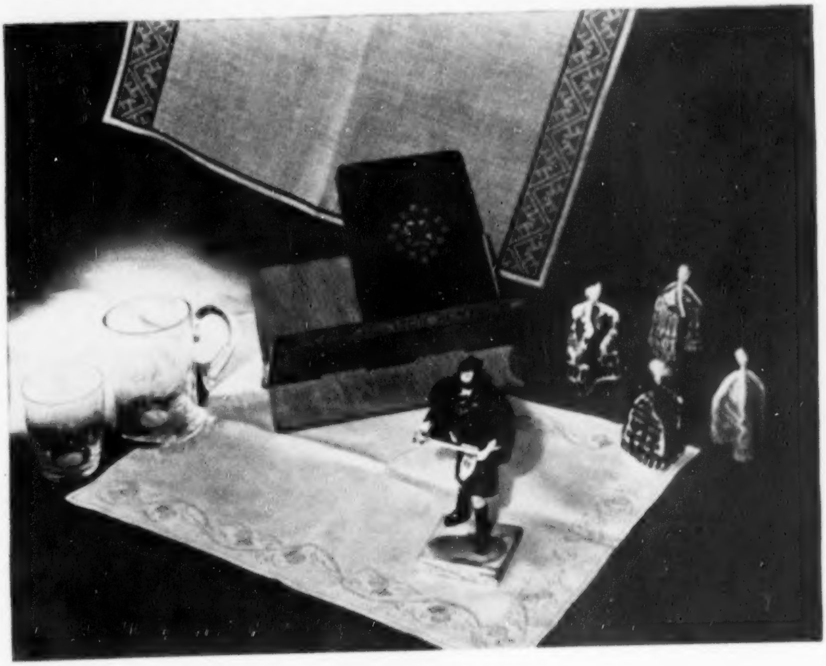
"Generally, it should be said that pottery and glass used to be flourishing Scottish industries and it is a pity that there are now so few exponents of these crafts working in Scotland. The native skill, I am convinced, is still there, and for glass we have certainly got more than enough excellent raw material in the fine sands available."



Some of the ceramic entries in the competition

Ceramic entries included in our illustrations are: set of three paperweights, partridge design in earthenware, by Ernest M. Dinkel; stoneware ash-trays, in hand-painted red grouse, partridge and black grouse, design by Miss Kathleen Horsman; beer glass with Mercury playing bagpipes, by Alison Geisler; tumbler, thistle design by Harold Gordon; a milk or cream jug with thistle decoration by Buchan; two creamers of traditional Scottish design by Miss Kathleen Horsman.

Stoneware ashtrays and paperweights, beer glasses and tumblers, ornaments with traditional Scottish designs, were among the souvenirs entered by competitors



Vitreous Enamels

Composition and Application Methods

Part 2

by

Mr. S. HALLSWORTH
(Metal Porcelain Limited)

A course of lectures on Modern Developments in Metal Finishing was recently held at the Northampton Polytechnic, London, and the following contribution is reproduced by arrangement with the Polytechnic and the author.

Preparation of Enamel

THERE are two application processes for vitreous enamel, the dry process and the wet. The dry process is used for large cast-iron vessels, such as baths, certain sanitary ware and copper and rare metals. Application to sheet iron and to the normal castings used in the manufacture of domestic appliances is by the wet process.

Wet process enamel, usually designated enamel slip or slurry is the powdered frit suspended in water by means of flocculating agents together with any colouring oxides required.

The enamel frit is prepared by grinding in a ball mill usually lined with porcelain blocks and using porcelain balls or flint pebbles as grinding media. For dry process enamelling this is very simple, the frit being simply ground to the required fineness for sieving on to the casting to be enamelled. It is, however, more intricate in the wet process method as finely divided frit is not totally colloidal, hence the necessity for flocculating agents.

An enamel slurry is a complex system consisting of a suspension of several solid phases in one liquid. The solid phases vary in particle size from minute grains to 40 mesh material and include constituents such as frit, clay, opacifiers and colouring oxides. The liquid phase is usually a water solution containing electrolytes in the form of soluble salts, acids or alkalis. The composition and properties of the solution affect the peptisation of the colloidal solids which in turn affect the suspension of all the solid phases present.

Although a slurry has some of the properties of a liquid, it also has some of the properties of a solid and therefore, it does not follow the simple laws of either. The flocculation and deflocculation of the colloids by soluble salts, acids or alkalis, control the suspension not only of the colloidal material, but also the non-colloidal particles. The variables in different enamels necessitate different methods of obtaining satisfactory suspension.

Clay is the most important addition

TABLE I. TYPICAL MILLING FORMULÆ

	Sheet Iron Ground Coat	*Sheet Iron Cover Coat*	*Titanium White*	*Wet Process Cast Iron Cream*
Frit	100 lb.	100 lb.	100 lb.	100 lb.
Clay	6 lb.	6 lb.	4 lb.	5 lb.
Borax	1 lb.			
Sodium Nitrate			$\frac{1}{2}$ lb.	$\frac{1}{4}$ lb.
Bentonite			$\frac{1}{2}$ lb.	
Tin Oxide		4 lb.		3 lb.
Cream Oxide				2 lb.
Water	50 lb.	38 lb.	38 lb.	36 lb.

in an enamel slurry to give suspension. It is also a necessary addition to give the dried slurry an adherence to the ware and a hardness which permits handling. The electrolytes have more of a chemical action which, either alone or in combination with clay, bring about the suspension of the enamel frit. Some of these electrolytes, such as the salts of magnesium, calcium and barium tend to form gelatinous compounds which assist by means of their physical characteristics. Other salts, such as borax, form buffer solutions which, by this means, control the alkalinity of the solution thus influencing the suspension because of their peptising action on the colloidal material present.

Table 1 shows typical milling formulæ. The frit is weighed and charged into the mill followed by the clay and other materials. The enamel is ground to definite standards including fineness, specific gravity and mobility.

After the enamel is milled to the correct consistency it is screened to eliminate coarse particles of frit which may interfere with tho spraying or cause lumps in the enamel coating.

Pretreatment Prior to Enamelling

It is essential that components for enamelling shall be free from grease, scale, oxide, etc. The lubricating oil used during fabrication can be removed by grease burning, trichlorethylene degreasing or alkali cleaning. Grease burning is usually carried out in the enamelling furnaces and although it is very suitable for hollow-ware with beaded rims, it is rather costly and in addition results in the formation of oxide which has to be subsequently removed in the pickling process and the trichlorethylene or alkaline cleaner is more popular.

There are two main types of degreasing plants: (1) vapour only; (2) vapour and liquid. The vapour type consists of a tank of suitable size containing a sump at the bottom and a coil containing running water at the top. The sump is filled with trichlorethylene and its temperature raised to boiling, which is, incidentally, 87° C. when a clear vapour is given off. The warm vapour condenses on the cold metal surface, dissolves the grease and falls back into the sump.

The chemical cleaner, usually held in a steel tank, consists mainly of sodium carbonate, sodium hydroxide, sodium phosphate and resin, and a 6 per cent. solution, approximately, is used.

Pickling

With regard to pickling, both hydrochloric and sulphuric acids are used for this operation. A 6 per cent. solution of sulphuric acid at a temperature of 140°-150° F. or a 10 per cent. solution of hydrochloric acid at room temperature are the usual concentrations.

Fig. 2 (Part 1) shows a pickling plant embracing acid tanks, water rinse tank, with constant running water to remove any excess of acid. The next tank is an alkali tank containing a small percentage of sodium oxide, introduced as sodium carbonate, to neutralise the acid. Then there is the hot water tank and finally, the hot borax solution.

Cast iron receives different treatment in its preparation for enamelling than sheet iron. Cast iron does not pickle satisfactorily and practically all castings are shot blasted before enamelling. In the majority of plants the castings are annealed before blasting. This serves a two-fold purpose in that it removes any oil from machining operations and also renders the castings more suitable for enamelling. Cast iron contains occluded gases which are given off by heat and once driven off are not reabsorbed. Annealing will therefore remove these gases and it also has a stabilising effect on the structure.

Fig. 3 (Part 1) illustrates an open annealing furnace. In appearance similar to a fusing furnace but the inner muffle is dispensed with and the products of combustion are introduced into the furnace.

Abrasive Cleaning

After annealing the castings are blasted by abrasive grains which are thrown against the ware. This may be done by using compressed air or revolving paddles. The abrasive usually used is chilled metallic grit. The abrasive is thrown with great force which removes the scale and roughens the surface, making it suitable for enamelling.

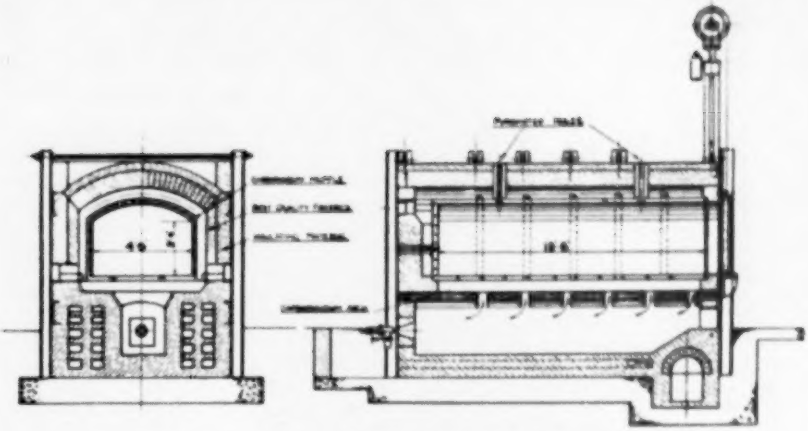


Fig. 1. Sectional drawing of an oil-fired furnace

Before the application of the enamel it is important, as has been previously shown, that the correct specification of enamel is used. Jewellery, copper, cast iron, sheet steel and aluminium invariably require different enamels and to a variable extent different methods of processing. I do not propose to deal with the enamelling of aluminium because although I do know that considerable development work has been carried out on this metal and that samples have been prepared in the laboratory I am not personally aware of any large scale production being done. At the same time, a special enamel is required and the methods of processing are in some respects different from that of iron and steel. As the enamelling of iron and steel is by far the most important part of the industry, I propose to restrict my discussion of methods of application to these two metals.

Methods of Application

The usual method of applying wet process enamels is by dipping, swilling or spraying.

Sheet iron ground coat enamels are usually applied either by dipping or swilling unless the size or shape of the articles make this impracticable. In the dipping operation the metal is immersed in the enamel slurry, withdrawn and allowed to drain. Complicated shapes have to be "rolled" through the enamel to ensure an even coating. Care is necessary to ensure that the predetermined consistency of the slurry is kept constant as the thickness of the enamel coating will vary accordingly.

In the older plants the ware is dipped in the slurry and then placed on bars over the dipping tanks to drain. The ware is subsequently removed from the bars and transferred to racks for drying or placed direct on the dryers. The use of a conveyor combining the dipping, draining and drying is beyond doubt a considerable improvement over the previous system where the operations were carried out separately.

Holloware, or articles having turned over, rolled or beaded rims cannot satisfactorily be coated by the dipping method. The enamel tends to build up in, or run back from, the rim resulting in an uneven coating and creating trouble in the subsequent processing. This type of article is immersed in, or covered with the slurry and on removal the surplus enamel is shaken off. Perforated drums used in electric washing machines differ in processing somewhat from standard, by reason of the fact that the enamel must completely cover the steel round the holes. Certain baffles inside the drum must be completely covered, and therefore the part is dipped in enamel, allowed to drain, and then taken from there and rolled. Special treatment is required

to obtain an even coating and to keep the holes free from enamel.

Spraying

Spraying is the application of enamel slurry to the ware by atomising it through an air gun, whereby the fine spray impinges on the ware. This method is used when only one side of the article is to be covered. Clear dry air is essential and filters are incorporated in the air line.

The cable conveyor combines spraying and drying and consists of a series of spray booths with the conveyor running through. Plates are placed on cables and the first girl sprays across one way and one edge, and the girl on the opposite side sprays that side until the whole operation is completed. It is then known that a suitable coating has been applied. It is simple to convert this into a mechanical spraying unit. Spray guns can be fitted on to arms which can be fitted on to a gantry, and movement can be obtained by cam action gears.

Drying

The drying of vitreous enamels is a comparatively simple process of removing the water which has been previously added to the enamel frit, and the only practical way of carrying out this process is by means of evaporation. In so far as the actual drying process is concerned, any method of applying heat to the ware can be used and, until recent years, little or no attention was paid to the principles of drying.

In practice, air movement is necessary and heat is required to accelerate the speed of drying. Heat changes the water from the liquid to the vapour state, and the air absorbs and carries the water vapour away. Heat also increases the absorbtion capacity of the air; for example, an increase in the temperature of air from 52° to 72° F. will double its power of absorbing moisture. At the same time air is quickly saturated with water vapour and it is therefore necessary that the air film in contact with the enamel is constantly removed.

It is quite possible to dry sheet iron enamels in the open shop without producing any enamel defects, but the process is very slow and requires considerable space. If, on the other hand drying takes place too quickly and without correctly designed dryers, case hardening of the enamel takes place which prevents the easy escape of moisture from under the surface which, together with the tension set up as the inner materials contract, causes disruption of the surface layer and results in tearing or crawling during the subsequent fusing.

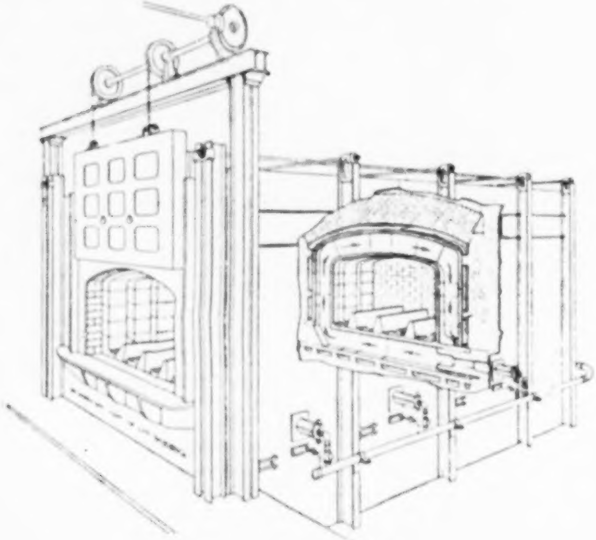


Fig. 2. Drawing showing details of a gas-fired furnace

From this it can readily be seen that the speed of drying depends upon the speed of flow of water to the surface of the enamel by capillary action, and successful drying can only be obtained where the water is removed from the surface of the enamel at the same or less speed than the water can rise to the surface. Increases in temperature increase the rate of moisture diffusion through the enamel, and the critical temperature and rate of drying is that which ensures the diffusion of the moisture through the enamel at the same speed as the outer surface loses its moisture.

The thickness of coating and the fineness of grinding also influence the rate of drying. The thicker the coating the slower the rate of moisture diffusion and the lower the temperature at which it can be dried and the finer the enamel the less readily can the particles accommodate themselves to contraction. The humidity of the air in close proximity to the surface of the enamel has some influence on successful drying and suitable ventilation or spillage is embodied in the design of dryer.

Room and box dryers still have their use and are indispensable in shops where a wide variety of article have to be processed, but where the type of products lend themselves to mechanical drying a considerable increase in production and reduction in cost could be effected.

Conveyor Types

Several conveyor type driers are in operation, one of the simplest being a box type dryer with a runway on the floor level. The ware after spraying is placed on the rack and then moved through the drier by a conveyor chain fitted with lugs.

A development of this system is the conveyor drying oven. The conveyor is of the double chain and crossbar type. Suspended from the crossbars is a central support to which is attached five pairs of knife edged bars where the castings are placed from both sides. A pair of spray booths is placed adjacent to each opening making a total of sixteen booths to one oven.

Fig. 4 (Part 1) shows the inlet of a conveyor dryer for the drying of certain types of holloware. In this plant the body of the saucepan is swilled in the usual manner, the saucepan placed on a hook and the handle sprayed. The pan and hook are placed on a steel bar and when the bar is full the whole is transferred to the conveyor. The bar fits into slots on the driving chain and is carried through the dryer. The heater is on top of the dryer and drying is again by means of recirculation.

Infra-red conveyor ovens with the conventional slat conveyor running through the oven are in use. The heat is applied by means of a number of independent panel units. The unit consists of a special cast metal panel heated directly by means of a number of small gas flames.

It is claimed that with this type of heating considerable use can be made of convection currents emanating from the radiant panels thus combining to a large extent the speed of infra-red and the uniformity resulting from convection heating. This hot air may also be instrumental in the results obtained.

Fusing and Fusing Furnaces

The fusing of vitreous enamel involves not only the smelting of the enamel but many accompanying physical and chemical changes. We have discussed the effect of cobalt and its effect on adherence of sheet iron ground coats. To develop good adherence available oxygen is also necessary. This must come from either the atmosphere or some oxide at the surface of the metal. A thin layer of rust is always present on the sheet after drying and it is interesting to note that this disappears after fusing.

At the commencement of the fusing operation gases are evolved through the surface of the enamel after which the glass melts down to a smooth layer containing many minute gas bubbles. These gases probably originate from the iron, the enamel and from reactions taking place at the interface of the enamel and the iron.

Interesting phenomena can be observed during the ground coat fusing. A microscopic film was taken in America of this fusing process which showed first a microscopic tearing or cracking of the surface of the unmelted enamel. As the temperature increased the enamel curls

or ruffles up and melts with a wavy appearance. This gradually smooths out and appears quite clear. Soon afterwards, however, bubbling starts and the bubbles rise to the surface and burst. Different sizes of bubbles are evidenced, but as the fusing proceeds the large ones are eliminated and a number of nearly uniform size remain. The fusing of the sheet iron cover coat does not involve so many changes as the ground coat. The contract surface between the cover coat and the ground coat must be an interfusion between the two enamels.

As with sheet iron ground coat all wet process cast-iron enamels boil during fusing, but towards the end of the operation the bubbling quietens down and a smooth layer is formed. Again it is expected that this bubbling comes mainly from the iron, although a considerable amount may be produced by the reaction of the enamel with the iron. In practice it is necessary that correct support of the ware should be ensured in fusing, and that suitable heat resisting tools to prevent warping are used. It is essential that the metal from which the tools are made is of the non-scaling type in order to avoid small particles of scale flying off and falling on to the enamel. These tools should also be designed so that there is a low weight ratio between the tools and the ware in order to obtain a high thermal efficiency.

Control of time and temperature during the fusing process is necessary in the production of uniformly fused high quality enamel ware. Pyrometric equipment is now almost standard on fusing furnaces and where gas or electricity is used as a fuel, automatic temperature control is usually adopted.

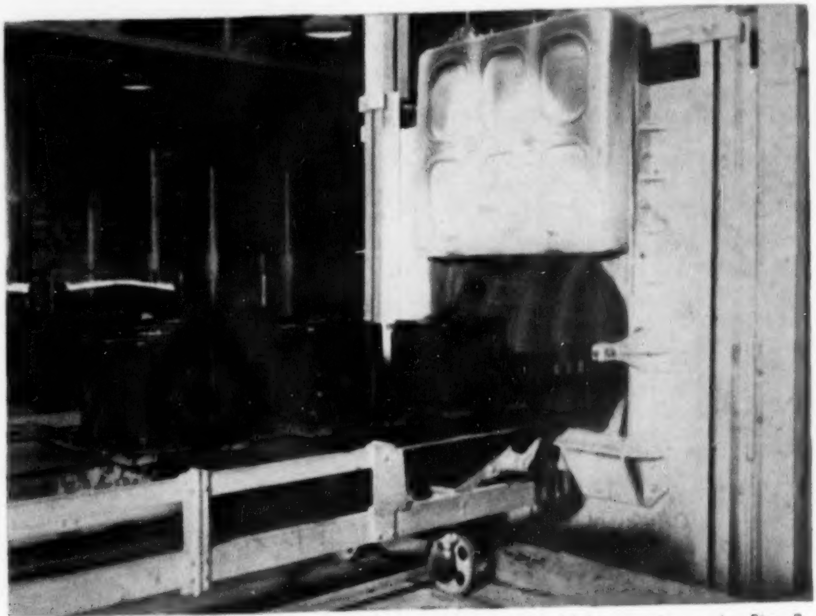


Fig. 3. Work entering a gas-fired furnace, details of which are shown in Fig. 2

Use of Muffle Type Furnaces

Furnaces used in the enamelling industry are of the full muffle type with the products of combustion circulating round the outside of the muffle. This is necessary in all types of fuel other than electricity, because sulphur compounds in contact with the enamel during the fusing process results in a scumming effect taking place, which destroys the gloss of the

enamel surface rendering the article unsuitable. The main difference between furnaces is the type of fuel used, the system of firing and the arrangement of flues. Several types of fuel are used, including coal, oil, producer gas, towns gas and electricity.

With the very early coal fired type the coal was actually burned in the combustion chamber, whereas the latest type consists of a separate though inbuilt producer, the gas passing through to the combustion chamber where it meets with the requisite amount of air for combustion.

Fig. 1 shows a sectional oil fired furnace. The fuel oil is burned in the combustion chamber and the products of combustion pass upward through flues on either side of the muffle, and are collected at the top and passed through recuperators either below or above the muffle and out to the stack.

Gas-Fired Muffle Furnace

Fig. 2 shows a section of a gas-fired muffle. The muffle consists of several sections or rings fired from opposite sides of the muffle by natural draught burners for operation on towns gas at normal mains pressure.

The live gases make a complete circuit of the muffle, before the spent products are discharged to the waste gas flues where they are used for preheating the combustion air. Adjacent tubular elements are fired contraflow, which automatically compensates for slight heat gradient and effects complete balance and uniformity of heating. It is claimed that with natural draught firing and with each element under positive draught potential escape of products from the elements to the fusing chamber is eliminated.

Fig. 3 shows a type of furnace, the elements of which are outlined on the sectional drawing in Fig. 2.

Typical vitreous enamelling furnaces are designed for enamelling steel baths, where the charging fork is near to the ground to facilitate handling.

In an electric furnace used for the firing of enamelled holloware the heating is effected by heavy section nickel chromium tape which is located in both the hearth and roof of the furnace chamber, directly radiating on to the work thus ensuring a high heat transfer. A typical furnace may have hearth dimensions of say 12 ft. long by 46 in. wide and be rated at 250 kw.

All continuous enamelling furnaces can be divided into three zones: the hot zone or fusing chamber, the preheating and the cooling sections.

In one type of furnace the ware is carried on specially designed racks or perritts on activated rollers. The other type of furnace embodies a split crown. The furnace chain passes over the roof of the furnace and the hooks or rods which hold the carriers pass through the space between the two sections of the crown. Whilst the latter can be straight through or horseshoe, the roller type is always a straight through furnace.

In the roller hearth type of furnace the ware is placed on the perritts and passes through it. At the end of the furnace a catcher table is situated to transfer the perritts from the furnace rollers to a return conveyor. The empty perritts are elevated by means of another table on to gravity rollers and then to the activated rollers. The use of photo-electric cells has been incorporated to control the tables and the furnace is heated by radiant tubes inside the furnace chamber.

MECHANICAL DRAUGHT

THIS publication 3501, published by Sturtevant Engineering Co. Ltd., Southern House, Cannon Street, E.C.4, supersedes a previous booklet, No. 1078. The booklet is copiously illustrated with illustrations of typical mechanical draught installations. It is pointed out the serious limitations in boiler output and inevitable loss of heat through the chimney where natural draught is used. Experience shows from 25 to 35 per cent. increase in steam output without heavy expenditure on additional boiler plant; alternatively if the boiler output is sufficient, lower grades of fuel may be used if mechanical draught is employed. The subject of combustion and gas content of the flow gases is adequately described, and there is an interesting note on induced, forced and balanced draught. The question of grit elimination is discussed and reference made to typical cyclone layouts. Information is provided on fans for mechanical draught as well as for oil- and gas-fired boilers and furnaces together with pulverised fuel fans.

Work Measurement

Its Application to the Pottery Industry

by

H. A. F. ROWNTREE, B.Com.

At a talk given to the Hanley branch of the British Pottery Managers' Association on 15th May, 1950, H. A. F. Rowntree, B.Com., A.I.I.A., of Noel-Brown and Co. Ltd., Management Consultants, said:—

I SHOULD like first of all to make it clear that my remarks are not based on experience in the potteries only, nor in any one particular factory. Although it is frequently argued that the pottery industry is different from all other industries this remark applies equally elsewhere. I, of course agree that attempts to apply work measurement in the potteries meet with certain difficulties due to technical and craft characteristics of production but similar problems are encountered in every industry. I shall seek to make it clear that the principles enunciated will apply generally and that it is only in their detailed application that allowances have to be made from factory to factory.

I should like also to stress that I do not regard work measurement as some wonderful new branch of science and it would be very helpful, especially in our discussion this evening, if you would look on the subject as just a part of your normal daily work. There is a tendency for some people to overemphasise the possibilities of some management tools and for others to minimise their value. As is frequently the case, the middle way is best.

Use of Information

I do not feel there is any reason to discuss whether or not work measurement should be introduced to any particular works for it must be obvious that work is measured wherever it is done. The vital point is—how accurately is the work measured and what use is made of the information. The range of accuracy may be from an estimate of a week's output for an operator down to an average time in minutes or seconds for one element only of an operation. It is important to notice that a day's output is not the same as eight times the output of one hour, nor as the output of 480 times one minute. The closer the analysis the more revealing will it be. In particular detailed work measurement will disclose:

(a) The amount of time wasted.

(b) The amount of time spent on avoidable operations.

These two are not the same thing. By wasted time I mean time lost by operators when they should be working, quite apart from any considerations of fatigue which would be allowed for separately. Avoidable operations are those which are found to be unnecessary for the fulfilment of the task and which can be eliminated by modifications to the method of working.

Contrary to what is frequently supposed, there is nothing mechanical or inhuman about work measurement. Rather does it help to draw attention to inevitable human differences which are otherwise ignored. I have grouped the uses to which work measurement may be put, under five headings:

(a) As a preliminary to reorganisation.

(b) Costing.

(c) Planning and progressing.

(d) Training.

(e) Payment by results.

No importance should be attached to the order in which I have mentioned these uses because they are all part of the functions of management and will be found to a greater and lesser degree in any organisation. I must admit, however, that I purposely put "payment by results" last on the list because

there is, in my opinion, a tendency to regard this as the sole aim of work measurement and nothing could be further from the truth.

Preliminary to Reorganisation

One can make a useful comparison at this stage with the work of a doctor. Work measurement can be compared with the examination of a patient. The cure depends on the nature of the case and on the patient. In industry the information obtained from work measurement corresponds to the result of a medical examination. It will show the proportion of time spent on fetching and carrying or servicing operations, details of the length of time taken on different parts of an operation and whether these proportions vary among different operators. Examination of such results of work measurement will convince an observer that although money reasons are important in causing an operator to work, they are not nearly so vital as is frequently supposed.

It would be as well here to emphasise that in using this information prior to reorganising a job or department it is very desirable to inform operators and foremen of what is proposed and the reason for it. There is nothing sloppy about admitting that a worker is entitled to be treated as a thinking person. From experience in different factories it is very apparent that foremen and managers tend to collect around them workers of their own type and ability. In other words a good foreman will attract and create good workers and is able to maintain such an atmosphere of co-operation that the use of any technique such as work measurement does not encounter resistance from the operatives. It is only feared where it has not been explained and is therefore not understood. In this it is no different from any other management policy or technique and resistance to change due to ignorance has existed ever since people were first grouped together to work in factories. Even if the management knows something is wrong and has a pretty good idea what it is, work measurement will give a value to the losses being incurred and will indicate which are the more urgent tasks to be tackled.

Policy considerations may prevent the complete fulfilment of a project for reorganisation, as for example where labour can be economised but it is considered necessary to maintain a reserve of skilled labour which it is proposed to displace. Work measurement techniques can be used not only for indicating how much labour is surplus but also for planning where it can be used in reserve if such is the management's policy. The important point is that work measurement has indicated where labour is being wasted and if attention is not drawn to this a false impression is created among workers and management and unreasonably low standards of output are accepted as normal.

Costing

The detailed times obtained from work measurement will be found very useful for more accurate costing. I have the impression, confirmed in a number of instances, that whilst the general classification of articles for costing gives satisfactory results at the present time they are frequently based on a number of false assumptions. The count dozen ratios, whilst accurate perhaps as an overall average are very inaccurate in a number of particular instances.

As conditions become more competitive work measurement will be necessary to reveal these inaccuracies and prevent production of lines at a loss. It is fairly generally admitted that uneconomical under-cutting by firms ignorant of the fact that they were producing such lines below cost contributed to the deplorable condition of the industry before the war.

Planning and Progressing

Accurate information such as can only be provided by work measurement is vital for effective planning. Where this information is not available or is only available in terms of day or weekly outputs there is a tendency to plan for much lower production per head than is in fact attainable. This argument is of course a corollary to those used in connection with work reorganisation. Until an analysis is made by work measurement it is only possible to judge what has been the practice hitherto. Experience shows that however ardently a manager may chase higher outputs

and however consistently he may obtain them, if it is only by dint of persuasion and browbeating he is far from obtaining maximum production.

Planning and progressing should not be based on past history but on future requirements costed and sold with a knowledge of what can be done. That knowledge can only be obtained by work measurement.

Training

The amount of work and detailed information needed to implement a satisfactory training policy is frequently underestimated. By training I do not mean learning. The usual method of placing a new operator beside an experienced one and leaving her to pick up the rudiments of the job over a period of months is old-fashioned although unfortunately it is still frequently applied.

Modern training methods call for detailed information about the times taken for various elements of a manual operation so that the parts of the job may be practised separately. Analysis will show that one operator may be slow because she has difficulty on one part whereas another operator learning the same job is retarded for completely different reasons. It is only by comparison of progress with targets set from information obtained by work measurement that these difficulties can be discovered and overcome. It is only failure to discover these difficulties that causes so many jobs in the potteries to be classified as needing six months training instead of, as an example, three months. I say this with a full knowledge of the oft-quoted difficulties of craft technique and the argument that the industry is based on a natural product. I would remind you all, however, that this argument has been used and proved fallacious in every industry, because every industry uses natural products.

Even the engineering industry which is often envied for its apparent ease of measurement has to cope with difficulties of hardness and softness of materials just as is the case with the furnishing industry working in wood, and the textile industry with wool and cotton. The answer is, in fact, that the engineering industry has made the great effort in applying the technique of work measurement and not that it is peculiarly adapted to benefit from these techniques.

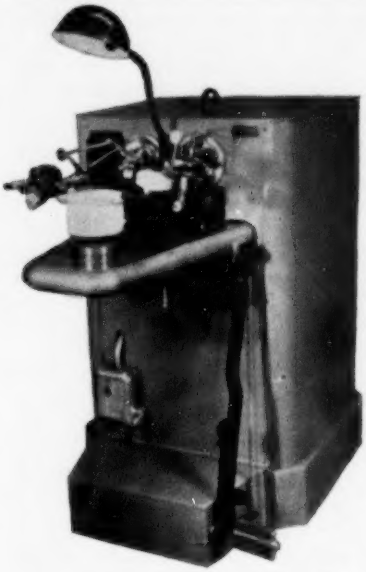
Payment by Results

Accurate work measurement is needed as a basis for any incentive scheme because for any one job there is only one just rate. I am not one of those who would seek to argue that the time study engineer is infallible. Indeed, in America, which admittedly covers a wide area, research has shown that there is a variation of plus and minus 15 per cent. in evaluations by different time study engineers. Nevertheless, within any one firm or industry a target of accuracy to within 5 per cent. is not impossible of achievement. This is obtained by detailed study of the job and is much more accurate than the method sometimes used merely by assessing what the output of an operation has been over a period of a week. Such an assessment cannot possibly be economic because it will include a large proportion of avoidable waste time. It is the aim of work measurement applied to incentives to allocate adequate rest periods and to eliminate waste time.

Wage Level

I argue that there can only be one just rate because if a rate is too tight, in other words if the operator has difficulty in reaching the target set, she will tend to lose heart and not produce the maximum output of which she is capable. Conversely, if the rate is too loose the operators will not need to work so hard to earn what they regard as their economic wage. I must agree there are exceptions, but your own experience will bear witness to the fact that there is in each industry and working class district a wage level above which the workers do not seek to rise. This does not mean that they would not accept the money if it were given to them but having regard to taxation levels, the variety of goods available in the shops and the use they can make of their leisure time, the extra effort to earn more money is not considered worth while.

The result is that any management which tries to secure an advantage or to overcome shortage of labour by raising its piece rates above the just rate secures only a temporary advan-



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tage. If all other managements in the district follow suit the advantage is cancelled out and the industry tends to be less efficient than it was before. Speaking very generally and relying on what managers and workers have told me from their experience, it would seem that before the war, rates tended to be too tight under the pressure of ill-regulated competition for markets and now they tend to be too loose under the pressure of competition for labour.

If work measurement were used more extensively, more information would be available to show what is a fair rate of output to expect from a worker. That is a constant which should not be varied by outside considerations.

DISCUSSION

Mr. Llewellyn, in thanking the speaker, questioned the suitability of work measurement for fixing rates in a craft industry where the production of a vase, to take an extreme case might be spread over a fortnight. He also referred to the immense variety of products handled in any one pottery. Mr. Goodwin also drew attention to the need for allowances to cover the numerous differences in time required for different articles and mentioned that he found the count system suitable as a broad average.

Mr. Rowntree appreciated the reasons which prompted these queries, but pointed out that provision of more accurate information would greatly assist both labour and management in arriving at a fair rate for a job and he deplored the present tendency to haggle over piece rates—a process where only too often external considerations of shortage of labour or orders and even personalities of the negotiators tended to influence the result unfairly for one party or the other.

On the question of the variety of articles, Mr. Rowntree pointed out that here again work measurement could be used to provide a much fairer assessment of the amount of work involved in producing and decorating a cup as compared with a plate than is allowed for at present in the system of count dozens. Whilst the count schedule may provide a rough and ready ratio for the industry as a whole, it cannot for this very reason be accurate for any one pattern or for the output of any one pottery unless by sheer chance this happens to conform with the average. From studies he had made on different patterns, there were glaring inaccuracies which cause confusion to the management in planning production and loss to the worker if the order requirements did not conform to the balanced output needed to offset so called good lines against bad lines.

Mr. Scott queried the effect of competitive world conditions on the assessment which resulted from work measurement. On a parallel point, Mr. Williams doubted whether there could be one just rate and mentioned that many people considered pre-war production per head had been higher than at present. He thought there was too great a tendency at the present time to expect money for nothing.

Mr. Rowntree replied that any difference in remuneration necessitated by world economic conditions should be reflected by changes in wage rates or the prices of goods in the shops. He maintained that the output per hour to be expected from any particular operation should not be varied once accurately assessed by work measurement. It was due to lack of work measurement before the war that labour considered it was exploited, at uneconomically low rates, whilst manufacturers complained that uneconomic production units were responsible for losses due to price cutting.

Mr. Hobson, of the Pottery Workers' Society, stated that he was interested in the general subject of time study and work measurement and noted with interest the amount of detailed work undertaken to arrive at an assessment of work values. He mentioned that it was the policy of his society at the moment to suspend judgment on

work measurement and to watch developments

Mr. George Mountford confirmed from his experience the need for assembling all possible information about each operation and felt that work measurement was essential for both employers and employees. It was the only way to avoid the dislocation caused by having to balance good jobs against bad jobs.

BRITISH CHEMICALS—A CHART

IN the recently-published report on the Chemical Industry prepared by the Association of British Chemical Manufacturers, 166 Piccadilly, W.1, there was a comprehensive chart setting out the principal products of the chemical industry and showing broadly how the starting raw materials are further treated and made into final products for most other industries.

There has been a demand for this from the Chemistry Departments of the Universities, Technical Colleges and so on, and the chart will be available on application to the Association at a cost of 1s. per copy, post free—cash with order.

INVESTIGATIONS INTO SCOTTISH CERAMIC INDUSTRY

THE Scottish Council (Development and Industry) is to appoint a committee to investigate the position of the ceramic, pottery, brickmaking and building materials industries in Scotland. A special sub-committee is being formed for this purpose and a grant is being sought from the Secretary of State for Scotland for the purpose. The Council believe that a considerable amount of work will require to be done on the subject of pottery production before any finalised decisions can be reached.

The Council is also proposing the creation of a Minerals Research Centre to examine and develop the lower grade mineral resources of Scotland. First move is to be the appointment of a director, after which a properly staffed research centre is planned. Meetings which have been held received cooperation from private and public sources in Scotland encouraging this policy.

Mechanisation in a Dry Grinding Silica Brickmaking Plant

by O. WINFIELD

Mechanical Equipments Ltd., Leeds

Because of the extremely practical nature of this paper and the tendency towards mechanisation, we are reproducing the paper in two parts. The first part deals with the primary stages of the process and the second part will cover the secondary operations. The paper appeared originally in the Transactions of the British Ceramic Society, Vol. XLVIII, pages 323-342 and is reproduced here by kind permission of the Society and Author.

(*Continued from "Ceramics," June,* 1950)

THE primary crusher product has to be further crushed to the final grain sizes required for the brick batch. A suitable machine in this instance (and the one selected for the purpose of this typical plant layout) is a cone crusher. Feeders should be fitted to take the 2½ in.-0 material from the primary bunker outlets to the cone crusher, since the latter required a controlled feed which can be set to give the best working conditions at the capacity required, operating in conjunction with the quantity of reject delivered from the screen.

An excellent type of feeder (two of which will be required for the case in point) is one which operates mechanically on the ratchet and pawl principle the latter controlling the rotary movement of the feed roll, with which the material at the bunker mouth is in contact. This is a relatively simple arrangement which avoids the possibility of jamming, and can be easily adjusted by altering the length of the crank arm.

The arrangement of the primary hoppers already described enables two totally enclosed mild steel chutes to be attached to the outlet flange of these feeders and to converge to a

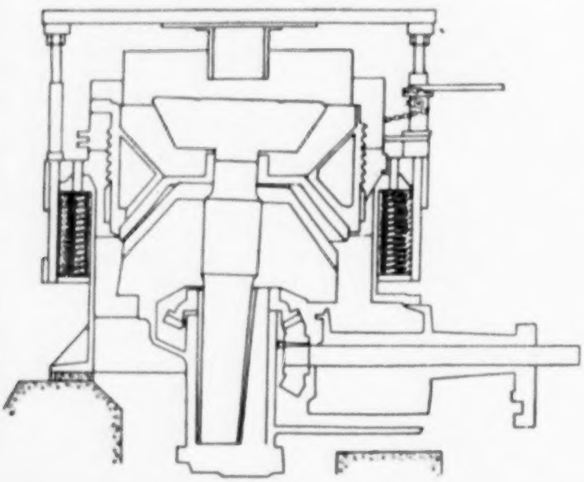


Fig. 1. Short-head cone crusher, ideal for secondary crushing

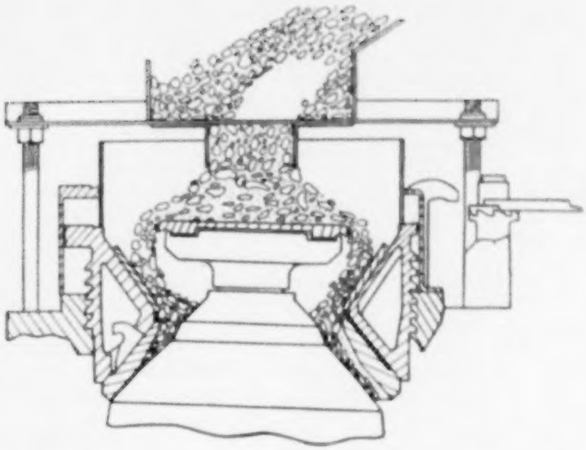


Fig. 2. Diagram showing correct feed box. Note that material falls on feed plate correctly

common position at the feed entrance to the cone crusher.

Secondary Cone Crusher

Assuming that the minimum requirements for the plant are about 35-40 tons of coarse grading and the same approximate amount of medium grading in an eight-hour day, together with about 15 or 16 tons of unrecirculated oversize for handmaking, the crusher would require to be of a capacity of approximately 15 tons per hour. The type of crusher suggested (see Fig. 1) is ideal for secondary crushing, because it works best in closed circuit. Its operation also provides freedom from dust production and gives a product of sharp cubical shape. This crusher requires a controlled feed as previously described, and has an adjustable feed table and spout for mounting a feed box together with chutes from feeders (see Fig. 2). Correct feed is important for the efficient operation of the crusher. The reason for mounting a box on the table as part of the exterior feeding system is to cause the incoming material to strike against the side of the box and to rebound, falling vertically through the spout orifice on to the feed plate of the machine. Thus the incoming material is evenly distributed around the crushing cavity, with all grades of material, fine and coarse, well mixed—this improves the crushing operation and ensures even wear of the bowl surface.

Incorporated in the plant is a flat double-decked screen fed by a secondary elevator from this crusher about which more will be said later. Suffice it to mention at this point that oversize material from the top deck of the screen is returned to the crusher as rejects, thus applying the principle of closed-circuit working of the cone crusher.

Methods of discharging vary according to the layout. In the example under consideration a secondary continuous bucket and belt elevator conveys the material from crusher to screen (see Fig. 3). Therefore, the appropriate arrangement for crusher discharge is a chute from the outlet to the feed hopper on the elevator. This chute should be designed to permit free and unimpeded discharge of the crushed material, which is essential otherwise any obstruction may cause building up of material under the crusher and serious damage to the machine.

Consideration should be given to the design of the whole foundation arrangement to ensure that the layout is substantial and rigid, but allowing easy access to the elevator and feed chute.

Secondary Elevator

This elevator, which deals with the product (about [illegible] in. down) from the secondary crusher, is similar in design and principle to the primary elevator. The capacity will also be about the same, *i.e.* 20 tons per hour nominal, but the buckets need not be extra

deep or wide like the primary buckets because now there are no extra large pieces to be accommodated. The feed chute from the secondary crusher to this elevator boot hopper needs to be fixed at a greater angle of inclination than that from the primary crusher to the primary elevator, because the bulk material is considerably smaller. In this case an angle of 40-45° is necessitated for free flow of the stone.

The main purpose of the elevator is to deliver the material to a grading screen to separate the sizes required to make up a batch of predetermined proportions, but before considering the screen, it is necessary to mention that the grades of sized particles for the batch include the provision of superfine (usually about 150 to 200 mesh). Assuming that these are to be produced by a ball mill (see Fig. 4), it is necessary to design the elevator delivery chute so that material conveyed by it may be by-passed to the ball mill as and when required.

Grading Screens

The various types of screen exhibit technical advantages and disadvantages, but it is not intended to enter here into the dynamics of screening nor to discuss the various principles involved, except in so far as the latter affect the mechanical handling from a practical point of view. It is generally accepted that of the two general classifications into which modern screens may be separated, those that are electrically vibrated, and those that although probably driven electrically, actually operate mechanically, the latter type are the more efficient when handling fairly coarse materials. In addition it is often possible to obtain a more positive conveying action with mechanical screens, particularly when considering horizontal screens.

It often happens that headroom is a vital factor, and that is a point in favour of horizontal screens, which can be simply supported on top of bins or bunkers into which gradings are fed direct. A good example of this is a single-deck horizontal, mechanically operated—or "jigging"—screen which is long enough to extend along the whole range of bins that it serves; the graded material passes through the appropriate screen cloth (starting with the smallest size first) directly into the corresponding bunkers. However, such an arrangement is only practical when the length of the series of bins is within reasonable limits. As the bin capacity suggested for the plant under consideration is beyond the scope of the arrangement just referred to, a double-deck horizontal screen is assumed to be required in this instance.

Apart from the superfines, which are dealt with separately, the screen must separate the material into two main grades, coarse and medium, in addition to which the oversize may be diverted from the screen if desired for use in a pan mill for hand-making special shapes and sizes outside the usual run of products made by machines.

Chutes

Whereas the main function of the crusher and screen combination is to provide material for the grading bins which, in turn, will be drawn upon for preparation of the batch, it is of advantage to make provision at the screen for each of the grades to be

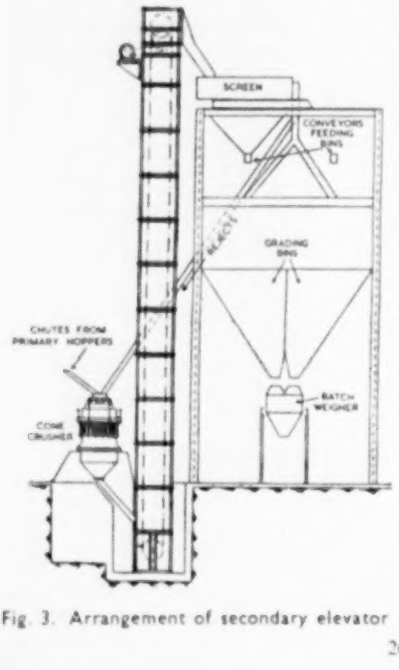


Fig. 3. Arrangement of secondary elevator

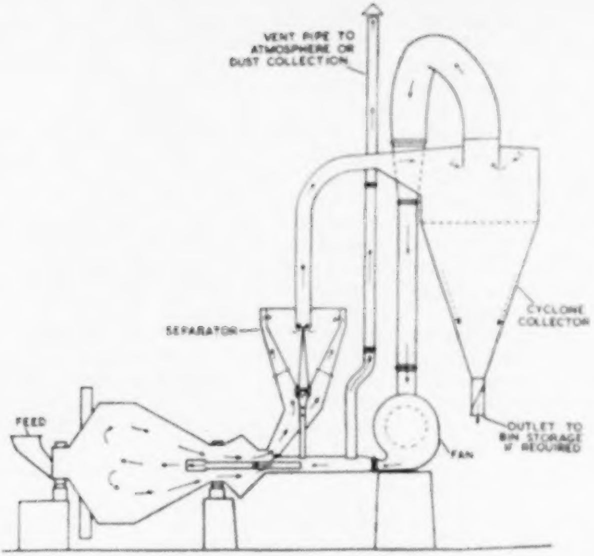


Fig. 4. Cross-section of ball mill and air separating plant

by-passed to the ball mill when desired. This arrangement gives valuable flexibility to the operation of the plant. Any of the grades produced (including the oversize, as already mentioned) can be diverted from grinding into fines in the mill when a satisfactory amount of that particular size of material is already in its respective bin. This method is also able to accommodate differing grades of stone, even where more than one quality is used in any one works, without the necessity for exact predetermination of the screen analysis of that stone. Ample supplies of fines for a plant of this nature are always an asset, and if the ball mill can work at almost any time to suit the availability of the various sizes of stone produced in the plant, much advantage is gained.

There is a trend in dry silica brick-making practice to use a low alumina silica sand for preparation of the fines as distinct from the crushing of stone for the other grades. A plant designed for the use of stone throughout is readily adaptable to this principle by having additional conveying equipment from a dried sand store to a hopper of suitable capacity feeding the ball mill.

All chutes required for the purpose just outlined must be totally enclosed, dust proofed and provided with replaceable liner plates. The ball mill should be situated as close as possible to the grading bin structure at the elevator and screen end of the range. Generally speaking, chutes should be designed to form as direct a line as possible from feed point to delivery, avoiding any awkward changes in direction within their length, which cause excessive wear at the point of change due to continual impact of the material. Care should be taken to ensure that the bottom surface of square or rectangular chutes is always in a horizontal plane, otherwise material will run down a corner angle of the section, causing restriction of flow and resulting in a tendency for the various grain sizes to segregate through friction between the outside surfaces of the column of material and the two sides of the angle.

Alternative Direction of Flow

Where bifurcation of a chute is necessary to provide alternative directions of flow, a simple flap-door arrangement is effective and easily operated (see Fig. 5). It consists of a flat plate of either cast iron or steel, of a width slightly less than the inside dimension of the chute and fixed to a

shaft, preferably of square section for that part of it within the chute, for easy attachment. The ends of the shaft extend beyond the chute sides, which can be reinforced locally to provide adequate bearing surface. A hand lever or chain wheel with sufficient length of chain to reach floor or platform level is keyed on to the protruding end of the shaft, and if necessary, according to the size and weight of the door plate, a balance weight arm may be fixed at the other end of the shaft to equalise the force required to turn the shaft and move the door. A force not in excess of about 30 lb. is usually assumed for easy manual operation and this can be accommodated by the length of the operating lever (or by the radius of the chain wheel), the length of the balance arm and the equalising weight. The free edge of the door plate is held in either position by stops welded or otherwise fixed to the inside of the chute side plates. It is necessary to ensure that the angle of inclination of the plate surface, when the flap is at rest in either position, is not less than that of the botton plate of each chute.

Simultaneous Delivery

If required, this simple type of door can allow simultaneous delivery from each of the legs of the "breeches" by being held in a vertical position. A quadrant fitted on the outside of the chute, drilled to take a pin through the operating lever handle, holds the door in this position quite effectively.

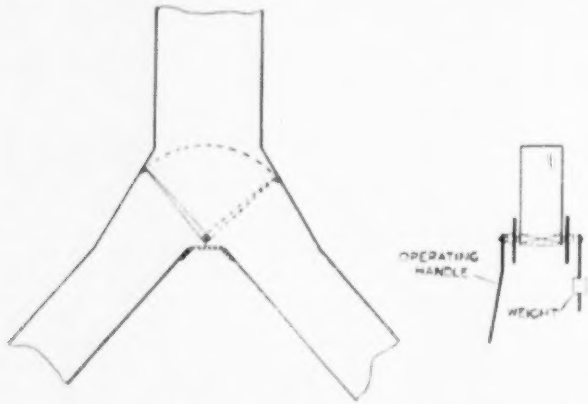


Fig. 5. Section through two-way chute showing flap door

To return to the discharge from the screen, the graded stone is fed to separate bunkers according to its size, and these bunkers are arranged in line to form a structural unit. The screen should be situated over, and at one end of the series so that the material for the first bin can feed directly down into it by chute. The rest of the grading bins are served by horizontal conveyors running from the screen along the top of the range to discharge at the appropriate positions, according to the size of material being conveyed.

An arrangement on these lines is illustrated in the plant layout (see Fig. 1. Part 1). The bins are shown arranged in pairs, each pair accommodating about 20 tons of material. Suppose that the first pair contains the coarse grading retained on the lower deck of the screen, the second pair mediums and the third pair the fines, delivered by the ball mill air gear to the cyclone separator above the bins, and from there by gravity chutes into the bins. One more pair of bunkers is required for the screen oversize for handmaking, as well as a bin or bins for dry lime.

Two conveyors are needed from the screen to deliver mediums and oversize, and these must be of the totally enclosed type, with provision made for intermediate discharge, on the assumption each will also be of sufficient length to deliver into the end bunkers for handmaking if and when required. There are two main types most suitably adapted to these con-

ditions—screw or spiral conveyors, and flight chain conveyors in which the material is propelled in a solid moving column by flights, thus eliminating excessive wear by abrasion.

Special attention must be paid to the design of bunkers required for storing graded material which is to be drawn upon for making a batch, to avoid segregation of the constituent particles. Otherwise, measured quantities drawn at different times will vary in average content. This is caused by the tendency of particles of different sizes to flow down the sides of the bunker cones at different rates when the bunkers are being filled, or when movement of the material takes place owing to discharge at the mouths.

Feeding Dry Lime

To leave for a moment the design of the grading bins units, it is necessary to mention here the arrangement for feeding dry lime into the lime bin. This may be suitably dealt with by a spaced bucket and chain elevator of comparatively low capacity, say about 6-10 tons per hour. The boot should be located in a pit in the floor adjacent to the lime bin. On top of the feed hopper in the pit should be fitted a grid, on which bags can be burst. The delivery chute for this elevator should be at an angle of not less than 60° and, as with the elevators handling silica stone, all joints in the casing should be sealed for dust proofing, and the connection of the discharge and to the cover plate of the bunkers must be made dust-tight. In the side of the lime bin itself, just above the outlet, a spout should be fitted for aeration, to allow free discharge.

Underneath the bunker mouths, for the length of the range, is the batch weigher platform, consisting of a rail track on which the batch weighing hopper, served by the bunkers, runs with a walkway alongside for the operator (see elevation "BB" Fig 1, Part 1).

The batch hopper, constructed of mild steel, is suspended on a carriage or bogey with flanged wheels for running on the rails. The hopper is fitted to a balance arm and a graduated dial is mounted on the carriage so that the operator can fill the hopper with measured quantities from each bin. The hopper top is shaped to accommodate exactly the delivery opening of the grading bin discharge mouths, which should be fitted with a sealing arrangement to prevent escape of dust when the bunker doors are opened. The mixers may be situated underneath the batch weigher track, and the lower part of the batch hopper is tapered to a discharge point so that, when the correct batch is obtained, it can be delivered direct to any of the mixers. The number of mixers required depends on the number of brick machines to be served.

The operator either pushes the batch weigher along (the wheels being fitted with ball bearings for the purpose) or propels it by a handwheel through a chain drive or gears to one of the axles. Stopping the machine at one of the bin discharge points, he operates the sealing arrangement by a simple lever, opens the bin door, which can be effectively operated on a rack and pinion sliding plate principle, and charges the batch hopper with the required weight of the size concerned. Closing the bunker door, he repeats the operation at all the bunkers as required. He then propels the batch weigher to a position over the particular mixer he is feeding and discharges the whole batch into the mixer. The supply of sulphite lye solution should be directed to a measuring vessel with ball valve control above the mixers, so that a measured quantity with water can be added to the batch.

It is found in practice that one operator can deal comfortably with the whole of the process just described, and at the same time be free to operate the electrically-controlled skip hoists that take the batch from the mixers to the brick machines.

Mixers and Skip Hoists

As previously stated the mixers are arranged in series under the batch weigher platform and approximately at ground level. The circular-pan type with bottom discharge is the most easily adapted to the layout described because a pit underneath the discharge chute can accommodate the low end of the skip hoist framework, allowing the skip (when at the bottom end of

its travel) to come to rest under the mixer. In general, all the skip hoists can be of similar construction and size except, perhaps, for one which may serve a small brick machine for producing arches and tapers, which no doubt constitute a comparatively small percentage of the total brick production. For this purpose, the mixer required would be smaller than the others and the relative capacity of the skip would also be smaller, to suit.

For the assumed output of approximately 100 tons per day, a total of four brick presses would be adequate. These would consist of one block-producing press, two table presses for squares and the small press mentioned for manufacturing side and end arches, etc. The feeding arrangement from the receiving hopper at the head of the skip hoists and over each machine may differ in detail according to the type of press concerned. If the press for making blocks were of the upright type, the final delivery of the material to the press table would be by spout or chute. A circular pan fitted with a rotating paddle arrangement on a central bearing should be mounted on the skip hoist framework, with the discharge from the receiving hopper feeding into the side of this pan (see Fig. 6a). In the bottom plate of the pan, on the opposite side of the centreline to the feed point, a hole or holes of sufficient area will allow the material mixed and scraped round by the paddle to pass through and fall via the spout on to the press table. Where the table type of press is used (see Fig. 6b), it is only necessary to provide a feeder such as the rotary table type at the hopper outlet for regulating the feed, as a paddle mixer is usually supplied as part of the machine and synonymous with the mould table.

Either single or double haulage ropes may be used on the skip hoists. In the former case a yoke on the skip to which the rope can be attached is necessary, since the actual pull must be from a position on the centre of gravity of the skip. The electrical control arrangement for the semi-automatic type of skip hoist consists of a top and bottom limit switch, a change-over switch and a break drum coupled to the motor. With this type the operator has to press the push button of the starter when the skip has taken the discharge from the mixer. The skip then travels up the track, over the curve to a tipping position, where it stops to discharge its load for the required period according to the time lag, after which

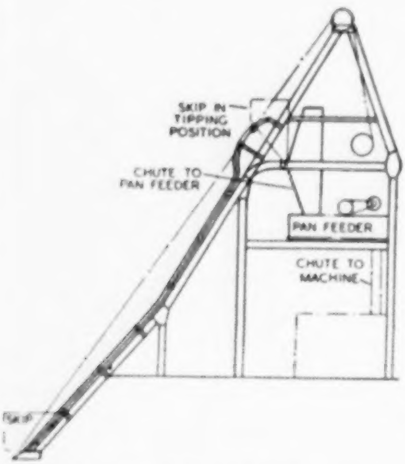


Fig. 6a. Skip hoist and feed arrangements to upright type of press

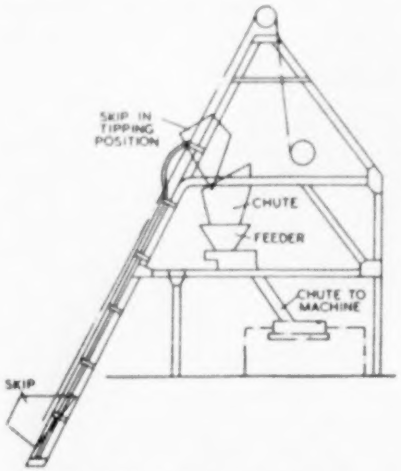


Fig. 6b. Skip hoist and feed arrangements to table type of press

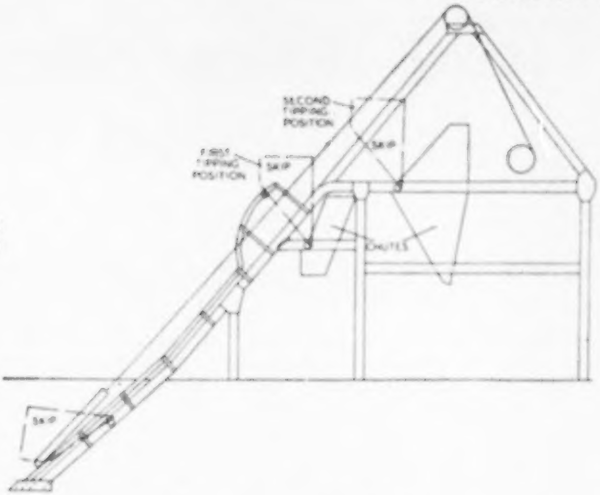


Fig. 7. Two point delivery type of skip hoist

the change-over operates, the motor is reversed and the empty skip returns to its loading position under the mixer, the power being cut off by the bottom limit switch which is tripped by to catch on the skip.

A useful purpose will be served if provision is made on one of the skip hoists for the track to have an intermediate branch between the base and the top tipping point (see Fig. 7). By using a simple catch-gear arrangement the skip can be caused to tip at this stage at any time, for instance when that particular brick press is out of use. An extra receiving hopper, fitted to take the discharge at this position, and with its outlet a little distance above the floor will serve to direct the batch into a barrow to take it away to hand-making benches or tamping machines after the addition of extra water at the mixing stage.

General Considerations

The handling of green bricks from machines to dryers and from dryers to kilns provides a problem in mechanisation not always easily solved. where tunnel-type dryers are used, the most common method is to load the bricks or blocks by hand as they come out of the machine moulds on to dryer cars built up with racks for pallets, and running on a narrow gauge track. This means the provision of a system of tracks and transfer tracks to serve all machines, to continue through the dryer tunnels and onwards to the kiln wickets where the cars are unloaded, and by one means or another carried inside the kilns for setting.

A more satisfactory method is to use the same type of dryer car as stillages, by having the carriage designed so that it can be picked up by a lifting truck whose low-built platform runs under the car, elevates the car clear of the ground, runs it to the dryer and sets it down on the rails which extend a little way out at each end. Similarly, outcoming cars containing dried bricks may be lifted up and transported to the kilns where, if the wickets are suitably made, the truck can run right inside with its load and the setter or his assistant can pick off each brick for immediate setting in the kiln. The method described eliminates the need for numerous tracks and transfer systems and, besides providing excellent manœuvrability about the works, allows easy access to kilns where their situation in relation to the manufacturing plant would entail a difficult problem if rail track were used.

In conclusion, the tendency to create dust of a harmful nature in a silica plant has already been referred to. Medical and Government authorities are becoming more and more interested in counteracting this condition, so that an efficient dust extracting system is a necessary part of a well-designed plant.

Fused Vitreous Silica–Its Properties and Uses

PART 2

Editorial article based on information contained in published papers and other data provided by The Thermal Syndicate Limited

Applications

PIPES for hot gases and acids, acid distillation units, condensing coils, "S" bend coolers, complete hydrochloric acid cooling and absorption systems, nitrating pots and cascade basin concentrators for sulphuric acid, are in use all over the world. The resistance of fused silica to attack by acids and many neutral solutions ensures the pure products so much in demand today. The heat resisting properties are also applied in the iron and steel industry, for example, in the use of pipes of rectangular section for use as bearer bars in the hot zone of a sheet metal annealing furnace, and special muffles for the bright annealing of wires and similar specialised work. More recent industrial developments include immersion heaters for the electrical heating of acid liquors used in chemical works and for plating baths, also air lift and ejector pumps, designed from data obtained in our laboratories, for handling acid gases and liquors.

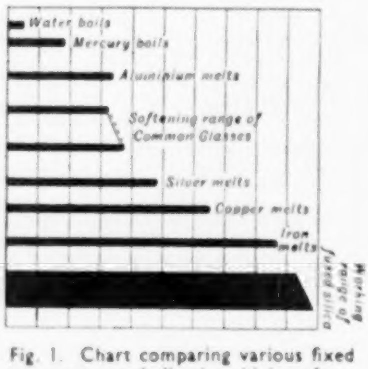


Fig. 1. Chart comparing various fixed temperatures indicating high softening point of fused silica

The low co-efficient of expansion of fused silica, whether transparent or opaque, puts it in a class by itself—its expansion being less than 1/6 of that of the best glass of the Pyrex type, and less than 1/20 of that of the high expansion glasses.

An interesting application of this property of low expansion with increase of temperature is in the use of fused silica rods as standards of length—for example as in the standard metre of the N.P.L.

We may next take the *relatively high softening plant*, which is shown in Fig. 1. This characteristic may be demonstrated by heating three rods of silica, Jena glass, and Pyrex glass (each clamped horizontally at one end) with three bunsen flames. The glass rods soon soften and bend, while the silica rod remains rigid.

Practical uses of these properties appear in such apparatus as muffles, retorts, pyrometer tubes and roasting trays, besides combustion tubes for high temperature determination.

Devitrification on Prolonged Heating

The next characteristic is an undesirable one—that of devitrification on prolonged heating. This is accompanied by a reduction in volume of 3 to 5 per cent., and the vitreous mass changes to a biscuit-like substance with a greatly reduced mechanical strength, consisting of crystals of silica in the form of crystobalite or tridymite—according to the temperature, time and other conditions of heating.

Fortunately, the action only begins at relatively high temperatures. N.P.L. tests show that loss of strength through devitrification hardly commences at 1,120° C., but is appreciable after four hours' continuous

heating at 1,140° C. Above this temperature continuous heating gradually converts vitreous silica into crystobalite. Heated continuously for eight days at 800° C. in the presence of a suitable catalyst, such as KCl and $LiCl$, vitreous silica is converted into tridymite.

Properties

The density of transparent fused silica is 2·21—that of the opaque variety being 2·07. Its hardness is of the same order as that of hard glass.

Bursting Stress (ultimate):

on Translucent Tubes, bore 0·4 in., ext. dia. 0·74 in. = 2,012 lb./sq. in.
on Transparent Tubes, bore 0·42 in., ext. dia. 0·75 in. = 6,500 lb./sq. in.
on Transparent Tubes, bore 0·12 in., ext. dia. 0·62 in. = 3,550 lb./sq. in.

Ultimate Compressive Strength

	lb./sq. in.
Transparent Rod up to 0·75 in. dia. ...	163,500
Translucent Rod up to 0·75 in. dia. ...	39,000
Translucent Tubes and Pipes up to 8 in. bore × 0·5 in. walls (approx.)	22,000

Elasticity (Young's Modulus) Transparent Fibres and Rods.

Temperature	lb./sq. in.
0° C.	$9·7 \times 10^6$
300° C.	$10·0 \times 10^6$
700° C.	$10·4 \times 10^6$

Modulus of Rigidity of Tranparent Fibres = approx. $6·75 \times 10^6$ lb./sq. in.

Hardness

Moh's Scale 5-7
Indentation Method, 318,000 lb./sq. in.

Impact Strength

	lb./sq. in.
Transparent	12,100
Translucent	11,750

Modulus of Rupture

	Transverse lb./sq. in.	*Torsion* lb./sq. in.
Transparent	9,200	6,750
Translucent	4,000	2,300

Tensile Strength (ultimate)

	mm./dia.	lb./sq. in.
Transparent Fibres ...	0·048	168,000
" " ...	0·014	87,300
" " ...	0·028	47,000
	lb./sq. in.	
Transparent Rods (0·25—0·6 in.)	4,000	
Translucent Rod 0·5 in. dia.		400 (min.)
" Tube 3 in. ext. dia. × 2 in. wall		800 (approx.)

On heating, fused silica becomes *more* resistant to shear up to about 1,000° C., being 7 per cent. higher at 850° than at normal room temperature. N.P.L. tests further showed a permanent increase of strength after heating to 1,188° for four hours and allowing the material to cool—due to the release of internal strain produced by the rapid cooling of the material after shaping in the plastic state.

Acid Resistance

The heat conductivity of opaque fused silica is practically the same as that of glass—0·0033 c.g.s. units. Its specific heat is 0·186 at 100° C. and 0·231 at 1,000° C. In chemical properties the chief virtue of fused silica is its resistance to acids; its besetting sin is surrender to the alkalis and metallic oxides, with which it combines to form glasses.

As to acids, the material is entirely unaffected by any acids or mixtures of acids, except hydrofluoric (in which its solubility is 1/10 of that of glass) and concentrated phosphoric acid, in which it begins to dissolve appreciably at about 300° C.

Corrosion by H.F. ..	
Glass	1,000
Fused silica	100
Quartz (parallel and perpendicular)	11 & 1

Fused silica is also quite insoluble in water at boiling point (which is not the case with glass), and in consequence the International Atomic Weight Commission recommended the use of silica vessels for analytical operations of high precision—except, of course, for the heating of alkaline and basic compounds. In this connection it must also be remembered that fused silica begins to volatilise below its softening point and that at temperatures above 1,350° C., small losses by evaporation begin to appear.

Owing to its resistance to steam and to temperature changes, transparent fused silica tubes are used as gauge glasses for steam boilers.

The low electrical conductivity of fused silica at high temperatures is shown as follows:

	At 15° *C.*	*At* 150° *C.*
Fused silica ..	$>2 \times 10^8$	$>2 \times 10^8$†
Jena glass ..	2×10^8	2×10^7†
Ordinary glass ..	5×10^5	1×10^5†
Porcelain ..	22×10^8	4×10^5

†See Campbell. Proc. Phys. Soc. 1913. 25. 336-7.

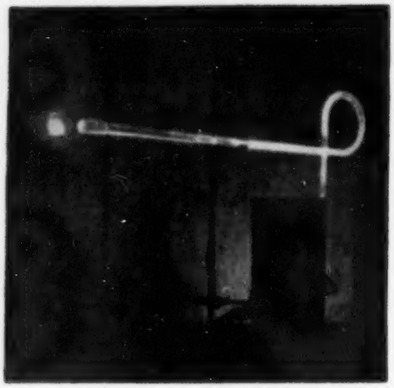


Fig. 2. Showing transmission of light through silica rock

Fig. 2 shows a solid rod of fused silica 120 cm. long, one end of which is heated to whiteness in the oxy-hydrogen blowpipe. The other end is thickened so as to form a rough lens. The light passes unaltered in colour—through a thickness of 120 cm., i.e. nearly 4 ft. of fused silica; it will be seen that though the rod is bent through three right angles the light is internally reflected and keeps within the rod. Even an appreciable amount of heat passes through a great thickness of fused silica as can be shown by the movement of the light spot on the galvanometer scale, when a thermocouple is placed in the path of the emergent radiation at the cold end of a silica rod (but without a thickened end), and the other end of the rod is heated. In working short lengths of rod in the blowpipe the operator must take care not to burn his fingers in the radiant heat which emerges at the *cold* end of the rod!

The resistivity falls at higher temperatures thus:

Temperature	230° C.	250° C.	700° C.	800° C.
Resistivity in Megohms per c.m.^{3}	$2 \times 10^{[illegible]}$	$2{\cdot}5 \times 10^{[illegible]}$	$3 \times 10^{[illegible]}$	$2 \times 10^{[illegible]}$

Fused silica has the further advantage over porcelain and glass as an insulator of being less hygroscopic, so that surface leakage is reduced.

The specific inductive capacity is relatively low—being 3·5 to 3·6 as compared with 5·6 for mica and porcelain.

Vaseline	2·2
Fused silica	3·5 to 3·6
Sulphur	4·0
Mica	ca5·6
Porcelain	ca5·6
Glass crown to flint ..	5·0 to 10

The dielectric strength of fused silica is equal to that of the best glass:

	K.V. per cm.
Commercial insulation oil	50—100
Glass	75—200
Fused silica	100—200

Fused silica has been successfully used as a high tension insulator for direct current in electrical precipitation plants for the treatment of flue gases, under conditions of heavy arcing which caused all other insulators to break down.

Optical Properties

As to optical properties, fused silica is, when free from bubbles, very transparent to ultra violet radiations, visible light, and heat.

The comparative transparency of fused silica to long wave-length radiation is shown in the following tables, which are due to Coblentz and Weniger in America.

	Thickness mm.	*Source Incandescent mantle 107u.*	*Hg. Arc filtered through blackcard 310u.*
Quartz ⊥ to axis	41·7	12·1%	58·9%
Fused quartz ..	2·0	12·5%	60·0%
Fluorite ..	59	5·3%	42·2%
Glass	·18	2·1%	25·9%

Fig. 3 shows the relative transparencies of various substances to ultra-violet radiation.

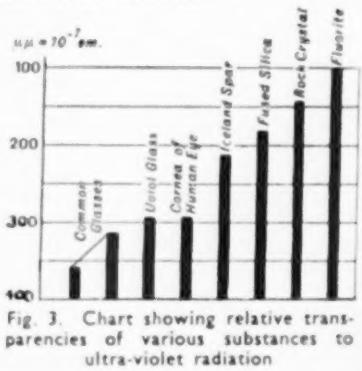


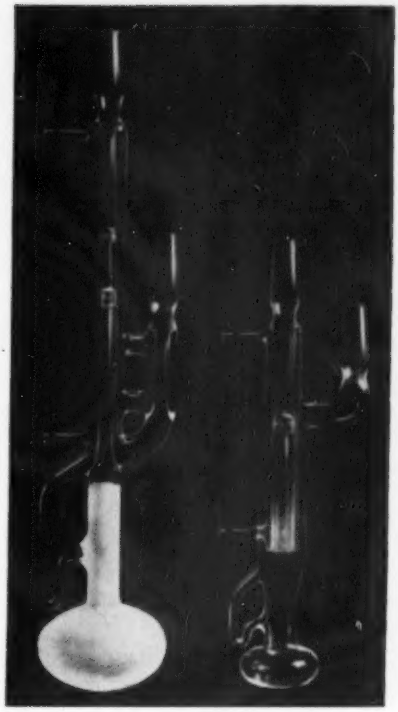
Fig. 3. Chart showing relative transparencies of various substances to ultra-violet radiation

The following data relating to transparency to ultra-violet light have been obtained on a piece of optical Vitreosil 11 mm. thick (B. K. Johnston, *J. Sci. Inst.* 1934).

Wavelength A°	*Transmission %*
2749	95
2573	95
2288	94
2144	93
1990	93
1936	90
1863	80

Fused vitreous silica, under the trade-name "Vitreosil" is manufactured in both translucent and transparent varieties, the former being supplied in either sand, satin or glazed surface as required whilst the latter always presents a glazed surface unless otherwise stipulated.

The translucent form is suitable for ordinary laboratory and experimental purposes where transparency is unnecessary. The transparent form is not only transparent to visible light enabling the progress of a reaction to be followed, but it also transmits Ultra-Violet and Infra-Red rays and is thus invaluable in connection with radio therapeutic, monochromatic and U. V. light apparatus. It can be supplied in highest quality for lenses, prisms and other optical purposes.



Vitreosil Mercury Vapour Jet Pumps, as supplied by The Thermal Syndicate Ltd.

The Fielden Electronic Hygrometer

THIS instrument was recently shown at the Physical Society's Exhibition in London, when it aroused great interest because of its simplicity in design and flexibility in application.

It consists essentially of two parts. An indicator mounted in a splashproof cast aluminium box suitable for wall mounting and a measuring head containing three temperature sensitive elements. One is the "wet bulb," the second is the "dry bulb" and the third a bulb which compensates for the prevailing ambient temperature.

The measuring head is connected to the indicator by 30 ft. of cable, thus allowing the former to be mounted in the most advantageous position for an average reading, while the latter can be mounted in the most suitable position for supervision by the operator. Within reasonable limits the cable length can be increased to suit any particular installation.

The instrument attains equilibrium in some 30/40 seconds, and this period can be considerably reduced if placed in a draught which is the recommended method of use. It offers for the first time a direct indication of relative humidity without any temperature corrections or calculations, and will give immediate and continuous indication of relative humidity for 40 per cent. to 100 per cent. at all normal ambient temperatures up to 200° F., with an accuracy of ± 1 per cent.

Under Development

We hear that Fielden (Electronics) Ltd., Paston Road, Wythenshawe, Manchester,

The electronic hygrometer, showing (left) the measuring head, and (right) the indicator, mounted in splash-proof cast aluminium box

have under development two other types of measuring heads, both of small dimensions. One is suitable for fitting into ducting to measure the relative humidity of exhaust gases and the other having the three temperature elements mounted in a narrow tube and being particularly suitable for measuring the relative humidity of gas flows of the order of a few cubic centimetres per minute. The readings obtained on the indicator can be recorded if required, on a circular chart recorder, and the relative humidity can also be controlled by a Microtrol Sensitive Relay, or controlled and recorded by a Servograph Recorder Controller.

Catalogue sheets describing the above instruments in greater detail are available from the manufacturers.

BRITISH ALUMINIUM APPLIED

UNDER this title we have received from the British Aluminium Co. Ltd., 46 Berkeley Square, W.1, a new publication. In it is described the rapid development of the aluminium industry since 1939.

It is pointed out that the company is responsible for the whole output of Virgin aluminium ingot in the United Kingdom, which amounts to something like 30,000 tons annually.

Illustrations are given of the processing of aluminium coiled strip and sheets, together with the variety of different products such as corrugated sheet, extruded sections, tubes, treadplates and impressed sheets.

The booklet is available from the company to those interested in the use of aluminium.

WELDING RESEARCH

PUBLICATION T.22, "Memorandum on Faults in Arc Welds in Mild and Low Alloy Steels," by the British Welding Research Association, 29 Park Crescent, London, W.1, was first published in "Welding Research," Vol. 4, No. 1, February, 1950, and has now been reprinted.

Typical faults in arc welds in mild and low alloy structural steel construction are defined and illustrated; an outline is given of the reasons for their occurrence, and of the ways in which they may be avoided and corrected. To assist engineers, inspectors and welding supervisors in making reference to a particular detail, each weld fault is dealt with under the following common sub-headings: Description; Cause and Prevention; Effect on Strength; Correction.

The Memorandum contains forty-four illustrations showing typical faults. Copies may be obtained, price 2s. 6d., from the Association.

The Geo. H. Gascoigne Co. Ltd., of Berkeley Avenue, Reading, have developed Kee Boards to overcome the shortage of timber shelving (see illustration). These boards are manufactured from galvanized sheet steel and fit over a tube structure without fixing. The board is flanged at the sides to give adequate carrying capacity.

PHOTO ELECTRIC AND ELECTRONIC EQUIPMENT

WE have received from Radiovisor Parent Ltd., 1 Stanhope Street, London, N.W.1, leaflets relating to their photo-electric and electronic equipment. Subjects such as photo-electric safety guards for power presses, flame failure devices for coal fires, ovens, furnaces, kilns, etc.; a flame failure safeguard for all types of oil burners; a unit for the control of artificial lighting by daylight intensity; a smoke alarm which indicates smoke emission from chimneys, which is indicative of waste; a photo-electric burglar alarm and a light ray counting unit which can be fitted on to a conveyor or machine to record the number of units which have been dealt with.

MECHANISED PRODUCTION

A NEW leaflet is available describing the Flow-Link Universal Chain Conveyor System, and illustrations show its use for the handling of pram wheels during assembly; for painting, dipping, draining and drying gas cooker components; for spray painting automobile wheels and for carrying gas meters from assembly lines to storage.

The Flow-Link Overhead Conveyor takes its power through a vee-belt drive, which is either fixed or variable, to the input shaft of the vertical output worm reduction gearbox. Thence power is transmitted by a Triplex chain to the driving sprocket, which in turn engages and drives a Flow-Link Chain. Standardised sections include vertical and horizontal bends. The standard chain has 2 ft. 8 in. centres of load carrying trollies, but 1 ft. 4 in. pitch chain can be provided for special conditions. The correct chain tension is obtained by intermeshing sliding fingers, thus maintaining a continuous surface on which the control wheels run.

Another leaflet describes the "Flow-stack" pallets for material handling and mobile storage. It outlines a large variety of different types, together with the "Flow-jack"—an all-steel truck with a hydraulic raising and lowering mechanism.

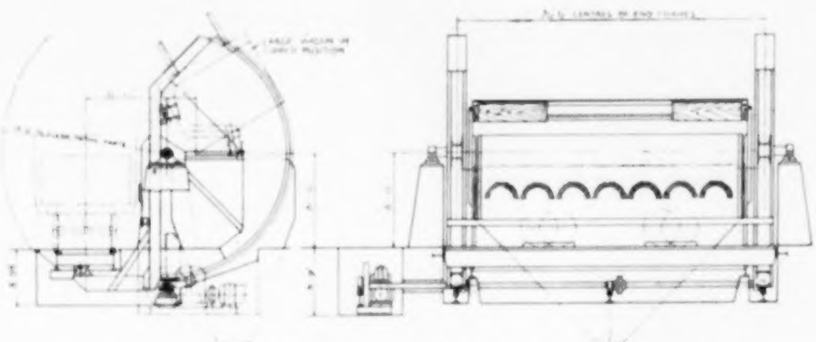
There is also available an excellent booklet entitled "A Survey of Material Handling" which covers every aspect of this important subject.

The above are available from Fisher and Ludlow Ltd., Material Handling Division, Bordesley Works, Birmingham 12.

WAGON TIPPLER

STRACHAN AND HENSHAW LTD., Steelhoist Works, Bristol, have issued a leaflet describing their Rotaside tippler.

It is claimed to be suitable for all types of wagons up to the 21 tons capacity normally found on British railways, although it can, of course, be adapted for rail gauges and wagons in other parts of the world. The wagon is lifted to quite an extent whilst being tipped, so that the discharge lip of the wagon side is 8 ft. above the rail level in the tipped position. Thus the receiving hopper can be built partly above the ground.



Drawing showing arrangement of the 20 ton Rotaside Tippler

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